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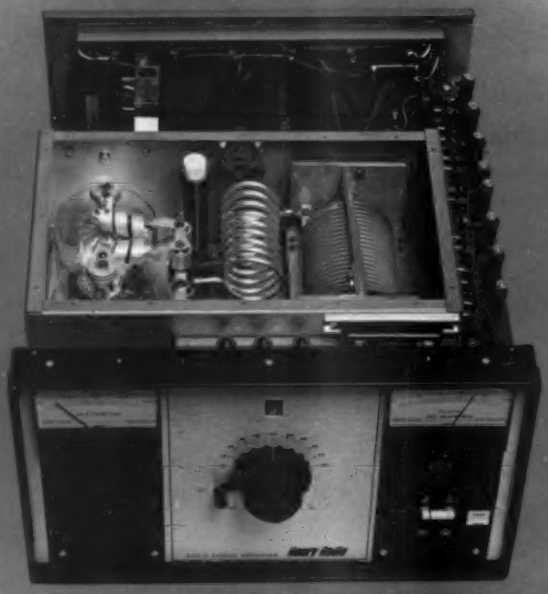
Before you buy an amplifier



Lift the Lid

Before you invest your hard earned money in a linear amplifier, consider what's inside. That's where the difference in quality is obvious. No lightweight, cheaply built components...In Henry amplifiers you will find only the best quality, heavy duty components. We build our amplifiers to perform at peak level month after month, year after year. Both the 2KD-5 and the 2K-4 will operate full legal power continuous duty on all modes. We offer the amateur the linear amplifier that we would want in our own stations.

At Henry Radio we know how to build only one kind of amplifier...the best!

2KD-5 GENERAL SPECIFICATIONS:

- The 2KD-5 is a 2000 watt PEP input (1200 watt PEP nominal output) RF linear amplifier, covering the 80, 40, 20, and 15 meter amateur bands.
- Two Eimac 3-500Z glass envelope triodes operating in a grounded grid circuit.
- Pi-L plate circuit with a rotary silver plated tank coil for greatest efficiency and maximum attenuation of unwanted harmonics.
- Full legal input in all modes. 2000 watts PEP input for SSB. 1000 watts DC input for CW, RTTY and AM.
- Jumper for 115 or 230 VAC, 3 wire single phase.
- 10.5" high x 15" wide x17.5" deep
- Price...$895.00

2K-4...LINEAR AMPLIFIER. Offers engineering, construction and features second to none. Provides a long life of reliable service, while its heavy duty components allow it to loaf along even at full legal power. Operates on all amateur bands, 80 thru 15 meters. If you want to put that strong clear signal on the air that you've probably heard from other 2K users, now is the time. Move up to the 2K-4. Floor console...$1095.00

TEMPO 6N2 brings the same high standards to the 6 and 2 meter bands. A pair of advanced design Eimac 8874 tubes provide 2,000 watts PEP input on SSB or 1,000 watts on FM or CW. Complete with self-contained solid state power supply, blower and RF relative power indicator. ...$895.00

TEMPO 2002. The same fine specs and features as the 6N2, but for 2 meter operation only. ...$745.00

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TEMPO VHF/UHF AMPLIFIERS. Solid state power amplifiers for use in most land mobile applications. Increases the range, clarity, reliability and speed of two-way communications. FCC type accepted also.

Model	Drive Power	Output Power	Price
LOW BAND VHF AMPLIFIERS (35 to 75 MHz)			
Tempo 100C30	30W	100W	$159.
Tempo 100C02	2W	100W	$179.
Tempo 100C10	10W	100W	$149.
HIGH BAND VHF AMPLIFIERS (135 to 175 MHz)			
Tempo 130A30	30W	130W	$189.
Tempo 130A10	10W	130W	$179.
Tempo 130A02	2W	130W	$199.
Tempo 80A30	30W	80W	$149.
Tempo 80A10	10W	80W	$139.
Tempo 80A02	2W	80W	$159.
Tempo 50A10	10W	50W	$ 99.
Tempo 50A02	2W	50W	$119.
Tempo 30A10	10W	30W	$ 69.
Tempo 30A02	2W	30W	$ 89.
UHF AMPLIFIERS (400 to 512 MHz)			
Tempo 70D30	30W	70W	$210.
Tempo 70D10	10W	70W	$240.
Tempo 70D02	2W	70W	$270.
Tempo 40D10	10W	40W	$145.
Tempo 40D02	2W	40W	$165.
Tempo 40D01	1W	40W	$185.
Tempo 25D02	2W	25W	$125.
Tempo 10D02	2W	10W	$ 85.
Tempo 10D01	1W	10W	$125.

TEMPO 100AL10 VHF LINEAR AMPLIFIER. Completely solid state, 144-148 MHz. Power output of 100 watts (nom.) with only 10 watts (nom.) in. Reliable and compact...$199.00
TEMPO 100AL10/B BASE AMPLIFIER...$349.00

Henry Radio also offers a broad line of commercial and FCC type accepted amplifiers covering the range of 3 MHz to 500 MHz. Henry amplifiers are in use all around the world. Commercial and export inquiries are invited.

Tempo solid state amplifiers are available at Tempo dealers throughout the U.S.

please call or write for complete information.

All of the above except the 6N2, 2002, and 2006 are available at Tempo dealers throughout the U.S.

Henry Radio

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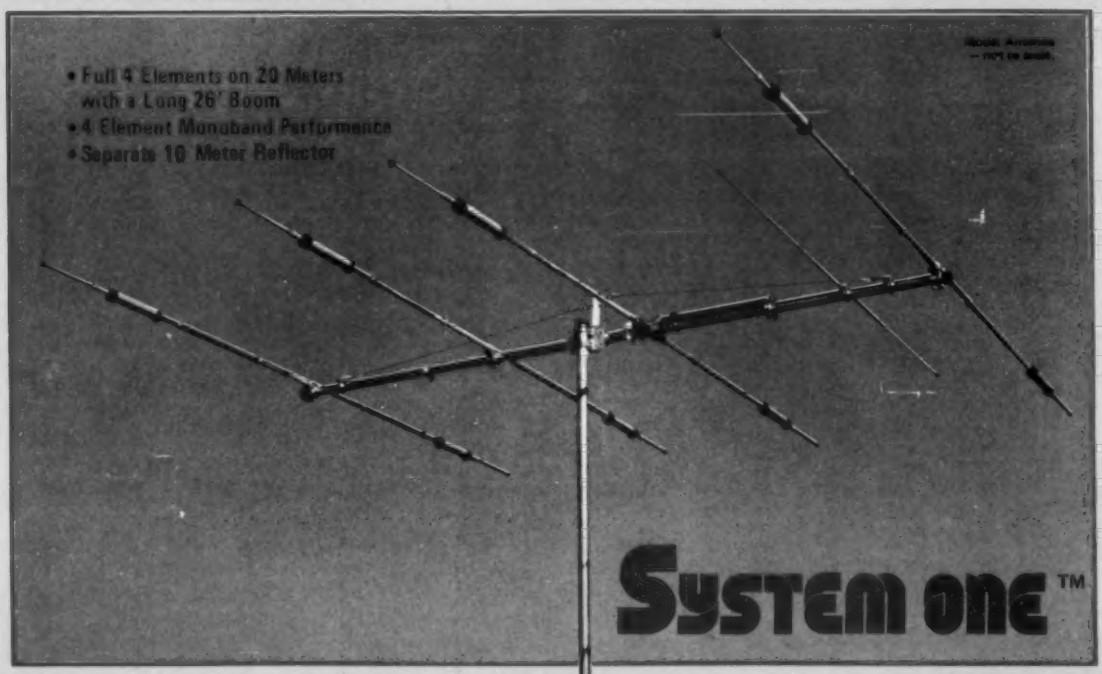
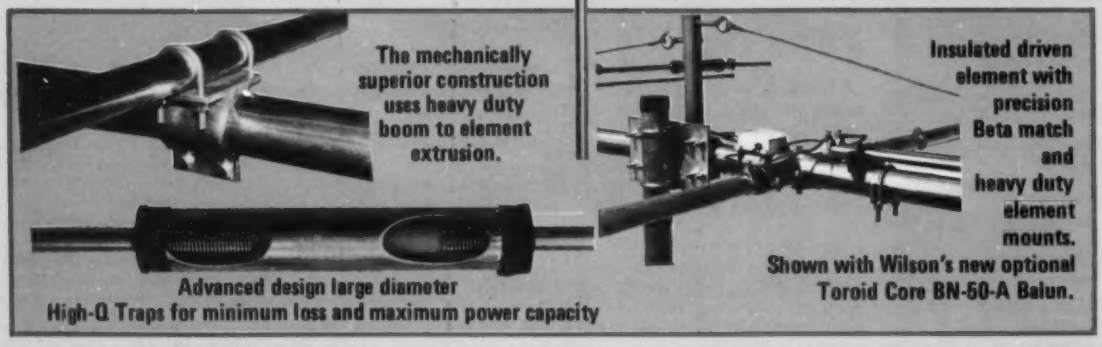
THE NEW INDUSTRY STANDARD OF PERFORMANCE . . . IS THE Wilson SYSTEM ONE!

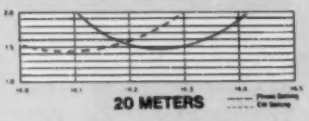
A DX'ers delight operating 20 meters on a full 26' boom with 4 elements, 4 operational elements on 20-15-10, plus separate reflector element on 10 meters for currect monoband spacing. Featured are the large diameter High-Q traps, Beta matching system, heavy duty taper swaged elements, rugged boom to element mounting . . . **and value priced!** Additional features: • SWR less than 1.5 to 1 on all bands • 10 dB Gain • 20-25 dB Front-to-Back Ratio.




The mechanically superior construction uses heavy duty boom to element extrusion.
Insulated driven element with precision Beta match and heavy duty element mounts.
Shown with Wilson's new optional Toroid Core BN-50-A Balun.
Advanced design large diameter High-Q Traps for minimum loss and maximum power capacity

SPECIFICATIONS: SY-1

Matching Method	Beta	Boom Length	26'	Required	
Band MHz	14-21-28	Boom Diameter	2" O.D.	Mast Diameter	2" O.D.
Maximum Power Input	Legal Limit	No. of Elements	5	Surface Area	8.6 sq. ft.
VSWR (at Resonance)	1.5 to 1	Longest Element	26' 7"	Windload at 78 mph	215 lbs.
Impedance	50 ohms	Turning Radius	18' 6"	Shipping Weight	65 lbs.
Gain	10 dB	F/B Ratio	20-25 dB	UPS Shipment in 2 Cartons	



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EDITORIAL BY WAYNE GREEN

ANARCHY VS. GOVERNMENT REGULATION

The ten meter linear amplifier ban is the first concrete example of radio amateurs being punished by the FCC for the transgressions of CBers. This means that, in the future, an amateur wanting to run a reasonable amount of power on ten meters will be in trouble one way or another.

Sure, we'll be permitted to build a maximum of one amplifier per year of our own, but no kits are permitted. I don't know about you, but I hate to think of the TVI a lot of poorly built and filtered amplifiers can create. Or, we can buy a rig with a kilowatt amplifier built in, and that isn't going to be cheap because the regs, with regard to preventing 27 MHz retuning, will run the costs up, as will the time-consuming and expensive FCC acceptance hurdles.

In terms of FCC regulations, I lean towards anarchy . . . that is, the fewer rules, the better. This is being called populism, of late. No matter what you call it, I've seen it work over and over with amateur radio, and I am disappointed (but not surprised) at the number of hams who have been unable to learn from history and who, thus, insist on trying to cure ham problems by increasing the number of rules.

It's funny about the FCC. Under Chairman Wiley, they set about a course of deregulation. I think that they were sincere in believing that this was their goal. Yet, in just about every case, their proposed rule changes turned out to be more regulation, instead of less. We've fought back and we've gradually been winning the war, but the winning has been so slow that few amateurs seem aware of the changes we've brought about.

How do you fight the government? It's difficult, obviously. They are the ones printing our money, and they will use any amount of our money to get their way, no matter how indefensible their way is. If their way turns out to be particularly bad, they set themselves up as the scorekeepers and issue periodic releases to the press and TV as to how great things are going.

A fine example of this is the National Highway Traffic Safety Administration (NHTSA) and their 55 mph speed limit. The May issue of *Car and Driver* exposes the NHTSA statistics on traffic safety to show, rather conclusively, that, using the government's own figures, there has been an increase in traffic deaths at 55 mph vs. those at 70 mph, after some other obvious factors have been taken into consideration.

Oh, yes, the gas saving . . . heh. It turns out, using the government's figures again, that the saving has amounted to about 1%, which is less than we could expect if we increased the pressure in our tires by two psi.

So, if the 55 mph speed limit costs more lives than a 70 mph limit, and it saves no gas, what is it there for? To make money. To make a lot of money . . . and, in that, it is a success.

Speed kills, right? Would you say it is the number one killer in vehicular accidents? Well, maybe number two? The statistics on fatal accidents are carefully checked and, in California, in 1976 (California is a good place to check, because everyone *has* to drive there . . . there isn't any other way to get around), driving over the speed limit was cited in 2.3% of the fatalities. That was 11th in the cause of fatalities. It is almost insignificant compared to drunken drivers (who were not speeding).

PREACHING REVOLUTION

There was a time in this country when citizens were able to get outraged over gross violations of their privilege of doing what they wanted as long as it didn't hurt others. There was a time when the people of the United States of America were so proud of their country that they took personal pride in its being first-rate, and they did something about it when lousy laws were pushed through. Today, I keep hearing on all sides that we must obey all laws, no matter how unjust or unreasonable . . . and we must not rock the boat. Remember that it is a waste of time to fight city hall, so knuckle under and play Uncle Tom.

It is seldom productive to openly refuse to obey the law. This gets you in jail, with a bunch of people jeering at you, and little else. But there are ways you can fight back, even today . . . heck, especially today. In these days of The Media, you want to take advantage of every edge you can get to turn things around.

FIGHTING THE FCC

First, do you intend to take the restrictions on amplifiers lying down? Aren't you the least bit irked at the injustice of it all? Are you really so dead inside that you don't give a damn?

If that reached you, then you are wondering what you might be able to do and probably hoping that it won't be much trouble and won't force you to put your name on anything . . . after all, no sense taking chances . . . right? I've seen people afraid to put their name on a petition to nominate a man for a political office. *Afraid!* Look here! If you care much about anything, you put your name out there where the politicians can see it. This is one thing you have which counts—you are a vote, and politicians spend more time getting votes than everything else they do combined. Their whole life revolves around the next election, even though you may not start to worry about that for two, four, or six years.

Okay, your name and support of a cause will help. It will help a lot. But you can do more than say "here, here" when someone with more guts than you gets up in the ham club and says, "Let's fight this travesty the FCC dumped on us." One man can do a lot. Two can do much, much more, if they cooperate so as not to duplicate the work.

Getting down to the nitty-gritty, what can you and your club do about the situation? Your first step is to read the rules and the recent changes. See any copy of a *73* license study guide for the rules, and read the complete unexpurgated FCC regulation changes in *73*. Decide what changes you think should be made . . . hopefully toward deregulation. Then start your campaign. You want to write to your congressmen and

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pacesetter in amateur radio

The TS-820S . . . known worldwide as the Pacesetter. Amateur Radio Operators universally respect its superb quality, proven through thousands of hours of operating time under all environmental conditions. The TS-820S has every feature any Amateur could desire for operating enjoyment, on any band from 160 through all of 10 meters.

TS-820S

You can always tell who's running a TS-820S. Its superb quality stands out from all the other rigs on the band . . . and when the QRM gets heavy, the TS-820S's adjustable RF speech processor, utilizing a 455-kHz circuit to provide quick-time-constant compression, will get the message through. RF negative feedback is applied from the final to the driver to improve linearity, and third-order products are at least —35 dB. Harmonic spurious emissions are less than —40 dB and other spurs are less than —60 dB. RF input power is 200 W PEP on SSB, 160 W DC on CW, and 100 W DC on FSK. Receiver sensitivity is better than 0.25 μV for 10 dB S/N. The TS-820S is known for its superb receiver selectivity, and its famous IF shift easily eliminates heavy QRM. That's why the TS-820S is the DXer's choice.

See your local Authorized Kenwood Dealer today.

TS-820S VFO-820S SP-820

Kenwood's unbeatable combination. The VFO-820 solid state remote VFO adds greatly to the versatility of your TS-820S. It has its own RIT circuit and control switch and is a perfectly matched accessory. The SP-820 deluxe external matching speaker includes audio filters for added versatility on receive and two audio inputs.

The TS-520S . . . the most popular Amateur Radio transceiver in the world . . . provides a foundation for an expanding series of accessories designed to please any ham . . . from Novice to Amateur Extra.

TS-520S

The TS-520S transceiver provides full transmit and receive coverage of all Amateur bands from 160 through 10 meters. It also receives 15.0 (WWV) to 15.5 MHz and another 500-kHz range of your choice in the auxiliary band position. With the optional DG-5, you have a large digital frequency readout when transmitting and receiving, and the DG-5 also doubles as a 40-MHz frequency counter. The TS-520S includes a built-in AC power supply, and, with the addition of the optional DS-1A DC-DC converter, it can function as a mobile rig. It features a very effective noise blanker, RIT, eight-pole crystal filter, 25-kHz calibrator, front-panel carrier level control, semi-break-in CW with side-tone, built-in speaker, heater switch, 20-dB RF attenuator and easy phone-patch connection. RF input power is 200 W PEP on SSB and 160 W DC on CW. Carrier suppression is better than −40 dB and sideband suppression is better than −50 dB. Spurious radiation is less than −40 dB. Receiver sensitivity is 0.25 μV for 10 dB (S+N)/N. Selectivity is 2.4 kHz at −6 dB/4.4 kHz at −60 dB and, with the optional CW-520 CW filter, is 0.5 kHz at −6dB/1.5 kHz at −60 dB.

See your local Authorized Kenwood Dealer for more information, and a super deal!

A great station . . . at an affordable price! The TS-520S with its companion accessories . . . including two new units. The AT-200 antenna tuner provides a versatile tool in any station. The other is the TV-520S, Kenwood's 2 meter transverter for SSB and CW operation from 146 to 148 MHz.

KENWOOD

pacesetter in amateur radio

The R-599D receiver and T-599D transmitter provide greater flexibility with more features than found in a transceiver.

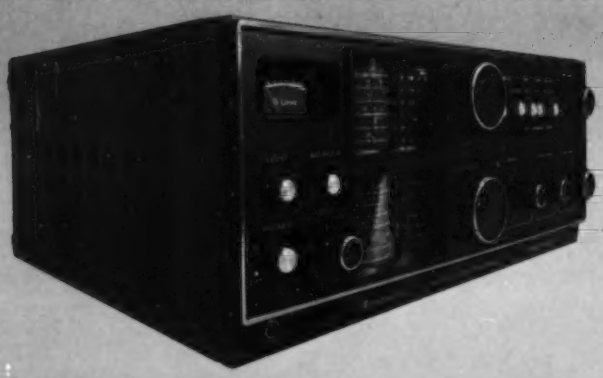
The R-599D receiver is all solid-state, covering all Amateur bands from 160 through all of 10 meters, as well as auxiliary band and WWV (10 MHz). With optional converters it also receives 6 meters and 2 meters. Modes include LSB, USB, CW, AM, and FM. A 2.2-kHz eight-pole filter is built-in for SSB, as well as a 500-Hz eight-pole CW filter and a 5.0-kHz six-pole AM filter. An optional 14.0-kHz six-pole FM filter is available. Also featured are an AGC control (slow/fast/off), 25-kHz calibrator, RIT, noise blanker, ANL (AM), squelch, monitor, VFO selector, and RF gain control which does not affect S-meter reading.

The T-599D transmitter is solid-state except for the driver and final tubes. It covers the 80 through 10-meter Amateur bands, on LSB, USB, CW, and AM. An AC power supply is built-in. Also included are VOX, and VOX, PTT, semi-break-in CW with side-tone, ALC, transverter terminal.

Enjoy split frequency control in four separate/transceive combinations with the 599D "Twins". See your local Authorized Kenwood Dealer for more information.

The 599D "Twins" are offered to the discriminating Amateur who appreciates the advantages of operating a separate transmitter and receiver.

R-599D/T-599D



R-300

The R-300 all-band communications receiver covers the following ranges: (A) 170-410 kHz; (B) 525-1,250 kHz; (C) 1.25-3.0 MHz; (D) 3.0-7.5 MHz; (E) 7.5-18.0 MHz; and (F) 18.0-30.0 MHz. It receives AM, SSB, and CW. The receiver features large, easy-to-read drum dials. Bandspread is calibrated for 10 foreign-broadcast shortwave bands, and a replacement bandspread calibration is available for the 80-10-meter Amateur bands. Included is a three-way power supply (AC/batteries/external DC). Wide and narrow ceramic filters are employed for high selectivity. Also included is a 500-kHz calibrator.

IT'S NEW . . . IT'S UNIQUE . . AND IT'S TRULY USEFUL. IT'S KENWOOD'S SM-220 STATION MONITOR. THE SM-220'S UNEXCELLED VERSATILITY ALLOWS YOU TO MONITOR YOUR TRANSMISSIONS, MONITOR INCOMING SIGNALS AND MONITOR THE AMOUNT AND STRENGTH OF BAND ACTIVITY* AND PERFORMS AS A GENERAL-PURPOSE 10 MHz OSCILLOSCOPE, AS WELL.

Kenwood offers this totally unique unit as a perfect compliment to your TS-820S or TS-520S station.** The SM-220, based on a wideband oscilloscope (2 Hz to 10 MHz), permits you to monitor your transmitted signals, thus assuring optimum linearity and maximum performance. With the addition of the BS-5 or BS-8 Pan Display option you will be able to determine visually the location and strength of adjacent signals without tuning your receiver off frequency. The choice of options allows you to adapt the SM-220 to either the TS-820 series or TS-520 series.

The SM-220 has a built-in two-tone audio generator with full provisions for tuning your exciter and linear amplifier (160 m through 2 m).

All this costs little more than a general-purpose oscilloscope. And, of course, it's a pure Kenwood quality.

*With BS-5 or BS-8 option

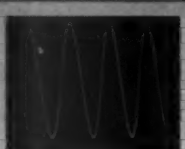
**For other models check with appropriate manufacturer for compatibility

SM-220

Two-Tone Wave Envelope For "performance" tune-ups or checking proper transceiver operation.

Pan Display Use to check source of interference during "QSO" without moving off-frequency. Also determines location and strength of adjacent frequencies. (Requires BS-5 or BS-8 option)

Keyed Waveform Shows detail of CW keying. Use to monitor the quality of your CW note. (Photo shows ideal waveform produced by TS-820S.)



Oscilloscope Operation (1 kHz) Oscillator function allows Sine, square wave, Lissajous patterns for testing or design work.

Trapezoid (TS-820S w/ TL-922) Shows linearity of power amplifier. Used primarily for testing.

Wave Envelope shows full SSB voice modulation, with processor on (full compression), and "clean signal" at full power.

KENWOOD

STILL THE SAME FINE, TIME PROVEN RIG. BUT NOW WITH THE SIMPLE ADDITION OF A PLUG-IN CRYSTAL, THE TS-700SP WILL BE ABLE TO UTILIZE THE NEW REPEATER SUB-BAND (144.5 to 145.5 MHz) STILL FEATURES ALL OF THE FINE ATTRIBUTES OF THE TS-700S. A DIGITAL FREQUENCY DISPLAY, RECEIVER PRE-AMP, VOX, SEMI-BREAK IN, AND CW SIDETONE. OF COURSE, IT'S ALL MODE, 144-148 MHZ, VFO CONTROLLED . . . AND KENWOOD QUALITY THROUGHOUT.

Features: 4 MHz band coverage (144 to 148 MHz) • Automatic repeater offset capability on all FCC authorized repeater subbands including 144.5 - 145.5 MHz • Simply dial receive frequency and radio does the rest . . . simplex, repeater, or reverse. Same features on any of 11 crystal positions • Transmit/Receive capability on 44 channels with 11 crystals • Operates all modes: SSB (upper and lower), FM, AM and CW • Digital readout with "Kenwood Blue" digits • Receiver pre-amp • Built-in VOX • Semi break-in on CW • CW sidetone • All solid-state • AC and DC capability. 10 watts RF output on SSB, FM, CW • 3 watts on AM • 1 watt FM low-power switch • 0.25 μV for 10 dB (S+N)/N SSB/CW sensitivity • 0.4 μV for 20 dB quieting FM sensitivity.

10 watts RF output on SSB, FM, CW • 3 watts on AM • 1 watt FM low-power switch • 0.25 μV for 10 dB (S+N)/N SSB/CW sensitivity • 0.4 μV for 20 dB quieting FM sensitivity.

TS-700SP

TS-600

The luxury all-mode transceiver for 6 meters. All solid-state. SSB, FM, AM, and CW.

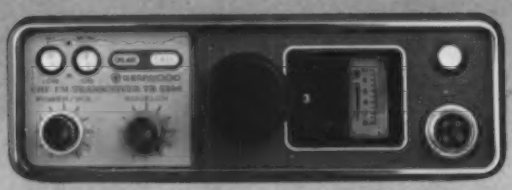
It's easy to work VHF DX on 6 meters with the TS-600 all-mode transceiver. The 10-watt, solid-state rig covers 50-54 MHz, with built-in VFO and 20 fixed channels. The main tuning dial is calibrated every 1 kHz for precise tuning. The built-in AC/DC power supply allows base and mobile operation. Other features include a noise-blanker circuit and RIT (receiver incremental tuning).

The fully synthesized TR-7400A 2-meter FM transceiver operates on 800 channels and features repeater offset over the entire 144-148-MHz range, dual frequency readout, six-digit display, and subaudible tone encoder and decoder. RF output is at least 25 watts!

The TR-7400A 2-meter FM transceiver provides fully synthesized operation, including 600-kHz repeater offsets, over the entire 144-148-MHz range. It can operate on any of 800 channels, spaced 5 kHz apart. RF output is at least 25 W, and typically 30 W. A low power position produces 5-15 W (adjustable). Included is a dual frequency readout with large six-digit LED display plus a dial readout. The subaudible CTCSS signaling feature may be used on transmit and receive, or transmit only. Optional tone-burst modules are available. Receiver sensitivity is better than 0.4 μV for 20 dB quieting. Large, high-Q, helical resonators minimize interference from outside the band. A two-pole 10.7-MHz monolithic crystal filter provides excellent selectivity. Optional active filters are available for 15-kHz "split" operation. Intermodulation distortion is down more than 66 dB, spurious rejection is better than −60 dB, and image rejection is better than −70 dB.

See your local Authorized Kenwood Dealer today, for a demonstration of the fantastic TR-7400A.

TR-7400A



TR-8300

FM transceiver for 70-cm Amateur band. 23 crystal-controlled channels (three supplied). Transmitter output is 10 watts.

The TR-8300 450-MHz FM mobile transceiver provides 10 watts output (switchable to 1 watt) on 23 crystal-controlled channels (three pairs of crystals supplied). The transmitter covers 445 to 450 MHz, and the receiver covers 442 to 447 MHz. The receiver includes a five-section helical resonator and a two-pole crystal filter in the IF for improved intermod rejection. Sensitivity is 0.5 μV for 20-dB quieting. A front-panel switch may be used to activate tone-signaling or other user-provided function. An LED indicates receive crystal functioning. A monitor circuit allows user to listen to his own modulation.

KENWOOD

INTRODUCING THE ULTIMATE IN RECEIVER DESIGN ...THE KENWOOD R-820

With more features than ever before available in a ham-band receiver. This triple-conversion (8.33 MHz, 455 kHz, and 50 kHz IFs) receiver, covering all Amateur bands from 160 through 10 meters, as well as several shortwave broadcast bands, features digital as well as analog frequency readouts, notch filter, IF shift, variable bandwidth tuning, sharp IF filters, noise blanker, stepped RF attenuator, 25 kHz calibrator, and many other features, providing more operating conveniences than any other ham-band receiver. The R-820 may be used in conjunction with the Kenwood TS-820 series transceiver, providing full transceive frequency control.

R-820

A **S-METER** Easy-to-read, calibrated to S9 +40 dB full scale and dB/μV.

B **STANDBY/RECEIVE SWITCH** Disables audio circuits during transmit mode with associated transmitter.

C **CALIBRATOR SWITCH** Built-in crystal calibrator, settable to WWV, provides signal every 25 kHz.

D **NOISE-BLANKER SWITCH** A specially designed crystal filter eliminates noise pulses such as ignition-noise interference.

E **MONITOR SWITCH** RF sampling allows user to hear his own voice when using associated transmitter.

F **AGC SWITCH** Automatic-gain-control circuit switchable to slow or fast response, or completely off.

G **RECORD JACK** Makes recording off the air simple.

H **HEADPHONE JACK** Provision for plugging in headphones.

I **MODE SWITCH** Selection of AM, CW, upper or lower sideband, or RTTY.

J **RF-ATTENUATOR SWITCH** 10 dB steps of attenuation from 0 to 40 dB, to prevent overloading from nearby stations, and for precise signal comparison.

K **DIGITAL HOLD** Locks counter and display while VFO is tuned to another frequency. Helps return to "hold" frequency.

L **VFO/CRYSTAL SWITCH** Permits VFO control or crystal control on four selectable frequencies.

M **LED INDICATORS** Light-emitting diodes indicate activation of notch filter, crystal-controlled reception, VFO control, and RIT.

N **DRS DIAL** Satin-smooth VFO tuning dial system provides easy, analog frequency readout (useful when digital hold is activated). LSB, USB, and CW frequencies are accurately read from the same pointer.

O **NOISE-BLANKER LEVEL CONTROL** Controls level of blanking, for maximum effect in eliminating noise interference.

P **MONITOR CONTROL** Adjusts level of RF sampling.

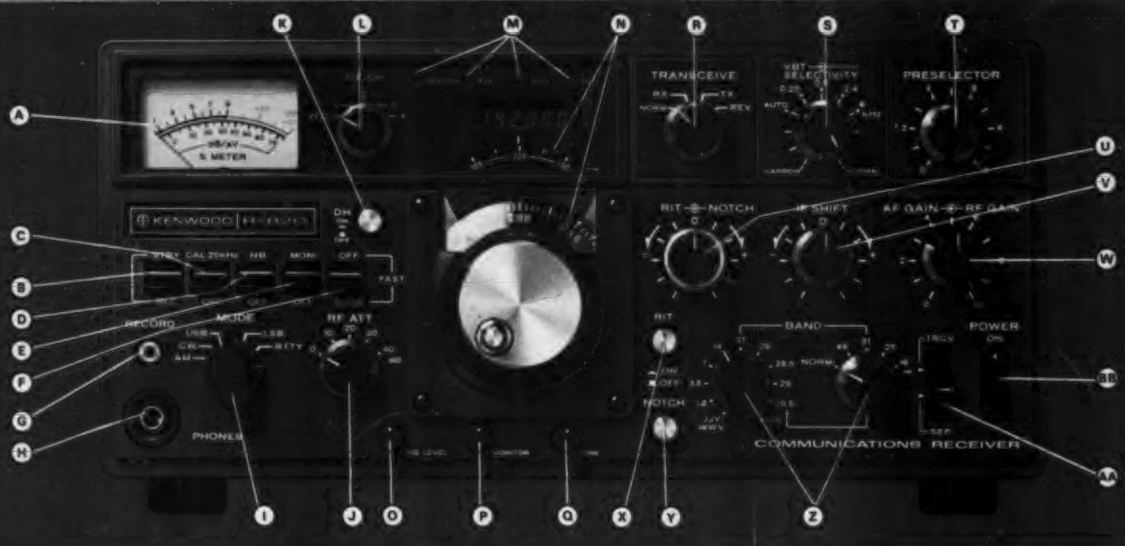
Q **TONE CONTROL** Varies audio-output frequency response.

R **TRANSCEIVE SWITCH** Selects frequency tuning from either the receiver or TS-820 series transceiver.

S **VBT/SELECTIVITY CONTROLS** Separate controls on the same shaft provide variable bandwidth tuning as well as selection of four IF filters: 250 Hz*, 500 Hz*, 2.4 kHz, and 6 kHz* (*optional). CW filters function in 455-kHz IF for superior shape factor.

T **PRESELECTOR** Peaks tuned circuits in RF amplifier stage for increased selectivity and sensitivity. RF amplifier coil is dual-tuned.

U **RIT/NOTCH CONTROLS** RIT allows receiver to be tuned off frequency, while not affecting transmit frequency, when in transceive mode with TS-820. Notch control tunes notch within IF passband for eliminating interference. Notch frequency remains the same, even when IF shift is utilized.



V **IF SHIFT** Varies (shifts) IF passband away from interfering signal.

W **AF GAIN/RF GAIN** Separate controls adjust volume and RF gain.

X **RIT SWITCH** Allows tuning off frequency with RIT control, and return immediately to VFO frequency by pushing switch.

Y **NOTCH SWITCH** Takes variable notch filter in and out of circuit.

Z **BAND SWITCHES** Selects frequency bands from 15 MHz (WWV), 160 through 10 meters, the 49, 31, 25, and 16-meter shortwave broadcast bands, and an auxiliary band.

AA **TRANSCEIVE/SEPARATE SWITCH** Enables receiver VFO to control the receiver and TS-820 (or TS-820S) frequency (or the TS-820 VFO to control both), or both can function independently.

BB **POWER SWITCH** Turns receiver on and off.

R-820 PERFORMANCE SPECIFICATIONS

Frequency Range:
- 160 meters (1.8-2.0 MHz)
- 80 meters (3.5-4.0 MHz)
- 40 meters (7.0-7.5 MHz)
- 20 meters (14.0-14.5 MHz)
- 15 meters (21.0-21.5 MHz)
- 15 meters (21.0-21.5 MHz)
- 10 meters (28.0-28.5 MHz)
- 10 meters (28.5-29.0 MHz)
- 10 meters (29.0-29.5 MHz)
- 10 meters (29.5-30.0 MHz)
- 19 meters (15.0 (WWV)-15.5 MHz)
- 49 meters (5.9-6.4 MHz)
- 31 meters (9.4-9.9 MHz)
- 25 meters (11.5-12.0 MHz)
- 16 meters (17.7-18.2 MHz)
- Auxiliary band

Modes: AM, CW, USB, LSB, RTTY

Sensitivity: 160-10 m, 19 m, SSB, 0.25 μV at 10 dB S+N/N
AM, 1.5 μV at 10 dB S+N/N
49, 31, 25, 16 m, SSB, 0.5 μV at 10 dB S+N/N
AM, 3.0 μV at 10 dB S+N/N

Selectivity: CW (with optional 250-Hz filter), 250 Hz (—6 dB), 500 Hz (—60 db)
CW (with optional 500-Hz filter), 500 Hz (—6 dB), 850 Hz (—60 dB)
SSB (2.4-kHz filter), 2.4kHz (—6 dB), 4.4 kHz (—60 dB)
AM (6-kHz filter), 6 kHz (—6 dB), 12 kHz (—60 dB)

Image Ratio: 160-10 m, 19 m, 80 dB
49, 31, 25, 16 m, 60 dB

IF Rejection: 160-10 m, 19 m, 90 dB
49, 31, 25, 16 m, 50 dB

Power Requirements: 100/120/220/240 VAC, 50/60 Hz, or 12-15 VDC

Dimensions: 13-1/8" (333 mm)W x 6" (153 mm)H x 13-3/16" (335 mm)D

Weight: 26.4 lbs (12 kg)

AT-200

The AT-200 is an antenna tuner, but it's also much more. It's an antenna switch, an SWR bridge and an in-line wattmeter. The AT-200 reduces the clutter and increases the operating efficiency of your station . . . and at a surprisingly moderate price.

The AT-200 features a seven position rotary switch that selects 1 of 3 antennas and connects it through the antenna tuner circuit or directly to the transceiver. The 7th position allows you to connect a dummy load directly to your transceiver for tune up and testing. Two of the antenna inputs are fitted with SO-239 type coax connectors. A third input allows for easy hook up of a wire antenna with an impedance of 10 to 500 ohms. The AT-200 may be used on all HF amateur bands from 160 to 10 meters. It's handsomely styled to match the TS-820S and TS-520S Series (and TS-820 and TS-520), but can also be used with any HF transceiver or transmitter of less than 200 watts output.

Frequency coverage: Amateur bands 1.8 to 30 MHz • Input impedance: 10 to 500 ohms • Maximum power capability: 200 watts • Insertion loss: 0.5 dB • Power meter: 20 watt/200 watt full scale • SWR meter measures up to 10:1 • Dimensions: 8-1/2"W x 7-3/8"D x 5-9/16"H • Weight: 6.2 lbs.

TV-506

TV-502S

OTHER KENWOOD PRODUCTS

ACCESSORIES FOR TS-820 Series 160-10-m transceiver
DG-1 digital frequency display
VFO-820 deluxe remote VFO
CW-820 500-Hz CW filter
DS-1A DC-DC converter
SP-820 external speaker with audio filters

ACCESSORIES FOR TS-520 Series 160-10-m transceiver
DG-5 digital frequency display
DK-520 digital adaptor kit for TS-520
VFO-520 remote VFO
SP-520 external speaker
CW-520 500-Hz CW filter

ACCESSORIES FOR 599D Series 160-10-m transmitter and receiver
S-599 external speaker
CC-29A 2-m converter
CC-69 6-m converter
FM-599A FM filter

ACCESSORIES FOR TS-700SP 2-m all-mode transceiver
VFO-700S remote VFO
SP-70 matching speaker
Other products:
PS-6 power supply for TR-7500 and TR-8300
PS-8 power supply for TR-7400A
VOX-3 VOX for TS-600/TS-700A
Active filter elements for TR-7400A

arma

TRIO-KENWOOD COMMUNICATIONS INC.
1111 WEST WALNUT/COMPTON, CA 90220

your senators, to the FCC commissioners individually, with copies to your congressmen. You want to get releases out to the papers, to TV stations, and to talk-show hosts. Get club members to personally visit congressmen either in Washington (if they happen to be there), or when the congressmen come home for a visit.

If you have any idea that petitions don't work, just try one on a politician and be amazed. Your congressional representative knows well that those signatures are votes . . . the things he has devoted his life to getting, at almost any cost. If getting the vote of you and your friends means bisecting the FCC, then the FCC will get bisected.

WE CAN SELF-GOVERN

Yes, I know all about the crazies. We've always had 'em. But one of the reasons I never miss a "Silent Keys" column is to watch for my favorite bad guys to make that final honor. But despite these mentally handicapped irritations, the mainstream of amateur radio manages to progress . . . particularly when the FCC acts so slowly that it does not have an opportunity to screw things up . . . which, fortunately, is a lot of the time.

In recent years, we had the transition from AM phone to sideband. This was accomplished by way of a "gentlemen's agreement" that sideband would use the top part of the 20m band and AM the lower part. Sideband gradually crept down until there was no AM left. Not without skirmishes with Those Who Fight Progress. FM repeaters also developed reasonably, when left alone.

In the early days of repeaters, we had wars between groups, but, after a while, reason prevailed and the repeater groups got together, forming coordinating committees and repeater councils. By the time the FCC came along with repeater rules, they were totally unneeded. Repeaters were about 90% coordinated throughout the country. Most of the wars had been cooled and things were relatively peaceful. One of the last things we needed were those repeater regulations.

Is it possible that amateurs could get together and develop their own rules? I think it would work. I think the FCC could get out of the ham business completely and amateurs would be able to govern themselves, with or without the ARRL. We could agree on allocations for the different modes, on band plans, and even on setting up our own licensing exams. We could also do a lot more to free ourselves from problems brought on by the crazies.

If we were self-governing, we could call out-of-line amateurs to task and put peer pressure to work. Repeaters would not spring up without coordination, if all of the repeater users would work together to discourage this. Uncoordinated repeaters could be forced to get off the air if amateurs would refuse to use them. We could take the time to get on and announce our desire that a repeater be coordinated before being opened for general use.

It comes down to this: democracy or dictatorship. And excessive government regulation certainly does not qualify as democracy. The rules we've been getting from the FCC could even be challenged in court—if we had an organization with the money and the guts to do it. Lacking any such, it is up to us as individuals to fight the only way we can . . . with letters to congress, letters to the Commissioners, with group actions through our clubs, and with releases to the papers and media. Yes, I'm preaching revolution against the FCC, using the tools which we know work and which are within the laws of our country.

WASTING TIME

Somewhere on my desk is a letter from a reader who says he has been trying to learn Morse code since 1914. Now he has bought my code tapes and hopes this will make the difference. It won't.

The only way I've found to get things done is go ahead and do them, whether I like it or not. Buying a code tape and putting it in a drawer is not going to do much, obviously. Even going to the extent of putting it under your pillow for mental assimilation will not increase code speed. Sure, my tapes make it easier to learn the code than any other way, but only if you take the time to use them.

Fifteen or twenty minutes a day is not much to spend on something as valuable and fun as a ham ticket. When you get up from some stupid television show you've been watching, ponder, if you will, on how much value this is going to have for you ten years hence. Hell, you won't remember the dumb thing very clearly next week, unless you go back under hypnotic regression. By next year, you'll be able to watch the rerun and wonder if you saw that particular episode during the first run.

As a registered procrastinator, I feel free to pass along gratuitous advice on getting things done. If I hadn't done exactly the same thing with the code, I would have had my ham ticket a couple of years earlier than I did. Two years of precious ham time was wasted because I wouldn't spend a few hours practicing the code.

Let's be honest for a moment. How many things that you consider important have you done in your life which didn't take a lot of time and trouble? I can't think of anything I'm proud of which didn't take a good deal of effort and determination. Now, how about getting going on your code?

MAKING MONEY

Every now and then, a ham says that he really can't afford to buy a subscription to *73* because he doesn't have the money. With all of the opportunities there are to make money, this is almost beyond understanding. Hell's bells! All it takes is the gumption to actually do some of the things which are obvious to us all.

Some years ago, I suggested that hams were ideally suited to getting into the security business. Several dozen readers took me up on that and I've had letters from many of them saying that they tried it and have done splendidly. It's certainly easy to get started, with several firms catering to your security supply needs with mail-order catalogs (such as Mountain West Alarm Supply, Box 10780, Phoenix AZ 85064; Emel Electronics, Box 146, Sheffield MA 01257; Ellin Alarm, 161 Bonad Road, Chestnut Hill MA 02167).

Businesses which can be run in spare time are great and they can be expanded to take over full time if they are more profitable than the old button factory.

Another great spare-time possibility is distributing magazines and books. There are thousands of smaller magazines which are looking desperately for help with this. Our experiments with local newsstand distribution of *73* and *Kilobaud* indicate that if the magazines are on display, they will sell. Unfortunately, most of the magazine wholesalers don't want to be bothered with small circulation magazines, so they won't deal with publishers. This is an opening for spare-time money-making. Just in the town of Peterborough (4500), an area representative can make about $25 per month, with one afternoon's work.

Our area rep program has shown that reps in many areas are able to make $300 or more a month with one or two days' work. That will buy a lot of magazine subscriptions, and could even build up your ham shack pretty fast. Contact our Marketing Manager, Dan Savage, and find out if your area is available for representation. You'd represent *73* and *Kilobaud* for sales on newsstands, radio and computer store counters, bookstores, hamfests, computerfests, etc. Some reps have made over $1000 in one weekend at hamfests!

With amateur radio equipment sales growing by leaps and bounds, you might be able to work part-time in a local radio store, managing their ham department. Almost every ham store has a desperate need for part-time help in servicing, too, if you're handy at that.

There are so many money-making opportunities in microcomputing that it is difficult to even suggest where to start. One thing is for sure: You should get your feet wet with one of the lower cost systems such as the KIM. These are expandable, and you'll end up understanding the things which will be of value to you in the long run . . . both in hardware and software. Teenagers are having a ball with this stuff, so it doesn't take a scientist to catch on.

In computing, people are making money by manufacturing, by opening computer stores, by servicing, and there is a big future in writing programs for the more popular systems. Programmers may eventually be the highest paid people in the business. One single program could easily bring in over $1 million in royalties as this field gets going.

If you put off doing things like this, life can slip away from you before you realize it. If you've got plenty of money and are living the life you like, then you're all set. But, if you have to worry about how much that new rig from Icom is going to cost, or whether you can afford to buy a new tower, or go on a DXpedition to Bonaire, then get the juices running and get into action.

You don't have to run with my ideas . . . you can think up your own. Once you start thinking in these terms, the opportunities are all around you.

MARCH WINNER

Solar power is in the forefront of the news these days, a fact somewhat reflected by the overwhelming vote for "The Solar-Powered Ham Station" as the best article in our March issue. Thanks for author Brian Kassel W5VBO's $100 check from *73* should go to the many people who cast reader service card ballots in favor of his article.

Speaking of the sun, we hope that Brian will consider spending a little of his loot for *The Propagation Wizard's Handbook*, written by our own John Nelson (73 Inc., $6.95).

LETTERS

RADAR AND RAPE

Along with my order for back issues, I would like to commend you on a fine magazine.

Besides the large number of practical articles by genuine electronics enthusiasts, the latest series of articles on the 10 GHz band has prompted this letter.

As I received the May issue today, I was pleasantly surprised to find the long awaited article (by John Franke) on countermeasures to police radar. As you may know, police use of radar in Ohio has been carried to the extreme. This has made the investment in anti-radar equipment a very practical move.

Please continue your policy of numerous and varied articles on new ideas in all phases of electronics.

Michael Niklas
Columbus OH

I just finished reading "Can Hams Counter Police Radar?" by John M. Franke WA4WDL.

I am anxiously awaiting your next articles on "How to Conduct a Successful Murder and Not Get Caught," "Rape in One Easy Lesson and Not Have a Worry," and "How To Hold Up a Bank and Never Get Caught." Of course, they will all have your approval.

Frankly, the article by Franke *stinks* and your approval brings *73 Magazine* to a new low.

You can argue till hell freezes over about the so-called possible damages of microwaves. But until the laws are changed, it's still the law, and contrived disregard for the law by writers like Franke and your approval add one more straw to breaking the American idea of law and order.

There would be no need for police radar if the driving public obeyed the 55 mph limit. That includes the trucker, the hot rodder, me and you, and all the rest who have a lead foot.

73 can certainly do much better than Franke's article.

Col. W. T. McAninch W4IIA
Falls Church VA

I find it hard to believe that *73 Magazine* would publish an article like "Can Hams Counter Police Radar?" To me, a ham radio magazine is about ham radio! In Mr. Franke's article, he has four methods of deception. Each of his four "methods" is a jamming system. So when did ham operators become interested in jamming? I personally would not like to be known as one of those ham jamming stations!

Most hams, I believe, try to do things the legal way. That's why we hams are hams, not DX CBers!

There is no reason for a ham to ever need a radar jamming device if he does not break any speed laws, which is what it boils down to. If a ham needs to jam radar, he is probably breaking the law. And hams do not need an image of lawbreaking.

If a person needs to jam or get "Smokey reports," let him get on 11 meters. Do not use the image of ham radio to pretty up these actions.

So leave the radar detectors and jamming systems out of ham radio. They have *nothing* to do with radio as an art!

Victor Curtis WA3YUV
Oxon Hill MD

The article in the May issue of *73*, "Can Hams Counter Police Radar?", proves that anarchy is alive and well in the United States. Never have I seen a more needless article published in the pages of your fine magazine. The author, John M. Franke, in his statement that there is a growing interest among the ham community in jamming police radar, makes a general assumption which I have yet to encounter. At last count, the proper way to change an alleged unfair, dangerous, or unpopular law was by the democratic process of the vote, not by the open advocation of disobedience. It comes as a considerable surprise to me that the editor of *73* would show such a lack of regard for the principles that make a democracy great. As to the author's question of the legal ramifications, it does not take a lawyer to observe that he is in violation of not only part 97, subpart E (Prohibited Practices and Administrative Sanctions) with regard to unidentified communications and interference, but he is also probably in violation of the various laws regarding the willful interfence of a policeman in the performance of his duty. And the author is most certainly in violation of using a car marked "for official use only," as pictured in the article, for an obviously personal matter. I would hope that in the future *73* would concentrate more on the quality of the articles presented and less on the quantity.

Thomas E. Verkler
Peoria IL

Police radar jammer?

Telephone "blue box," with national news coverage?

Calling IRS "bastards" in print?

Non-amateur computer and airplane columns?

And you expect me to renew?

This magazine has done more to harm amateur radio than any other source.

Steve Noll WA6EJO
Ventura CA

I am writing this letter in reference to your article on police radar jamming, May, 1978, issue, pages 80-82.

I wish to preface my letter by telling you that I am a Kentucky State Police Trooper and a licensed Technician class amateur.

I am somewhat amazed that your fine magazine would publish an article that I conclude is not an exercise in electronics, but an open statement that our national 55 miles per hour speed limit should be ignored. I do not wish to quote morbid statistics that show a decrease in highway deaths after the imposition of the 55 mph law, nor that the deaths have steadily risen since the CB boom, after the truck strike of 1973. But these are fact, though there may be other factors to consider. Ideally, we would need no laws, radar, or police for that matter, but we have shown we must be controlled to some extent.

I speak for myself and not the Kentucky State Police. In Kentucky, we enforce the speed law because it is the law and because we care about the people who travel our highways. We enforce the law with a degree of flexibility to allow for speedometer error, although this is not a written rule.

I would suggest that if we as drivers do not want the 55 mph speed limit, we change it. The money spent on radar detectors, CB radios, etc., could be spent to organize and influence Congress to repeal this law.

I would suggest, even though I have not researched this matter, that intentional interference with a licensed frequency may be illegal. All our radars are FCC licensed to operate on an assigned frequency and are checked to make sure they are maintained on frequency.

In closing, let me state that I enjoy your magazine, but feel that this type of article does not need to be part of it.

M. G. Stevens WA4SUV
Olive Hill KY

In the May, 1978, issue of your magazine, you published an article by John Franke WA4WDL of Norfolk, Virginia. This article encouraged the act of, and explained a procedure for, jamming radar devices used by law enforcement officials to detect speed limit violations.

Mr. Franke indicates in this article that his idea does not violate FCC rules, since the transmitter operates within assigned amateur frequencies. He therefore concludes that an amateur's license is not in jeopardy for using such a device.

Mr. Franke obivously has not read the regulation governing amateur radio operation. Such a device *is* in direct violation of at least two of the paragraphs found in Subpart E of the U. S. Rules and Regulations.

Paragraph 97.116: "The transmission of radio communication or messages by an amateur radio station for any purpose, or in connection with any activity, which is contrary to Federal, State, or local law is prohibited."

Paragraph 97.125: "No licensed radio operator shall willfully or maliciously interfere with or cause interference to any radio communication or signal."

Your magazine states: "*73* takes no stand in the developing warfare between police radar and hams interested in countermeasures. The more we read about it, the more convinced we are that police radar should be outlawed . . ." The last sentence, coupled with the publishing of an article which actively promotes illegal countermeasures, is an *obvious* stand.

A responsible publisher verifies the facts before printing. Is *73* so uninformed on amateur rules and regulations that it accepts without question the alleged legality of such a device?

Your ignorance of amateur regulations is inexcusable. The shadow you have cast over the amateur fraternity is despicable. With WARC close at hand, the last thing amateur radio needs is for a magazine such as yours to display regulatory ignorance and to encourage willful violation of the law.

This censure was requested by and unanimously approved by the membership at the May meeting of the Triangle Ama-

Continued on page 41

IC-211, the 2meter Maximizer

COMPUTER-COMPATIBLE 4 MHz TRANSCEIVER WITH 2 VFO'S

ICOM's **IC-211** maximizes band coverage, speed, performance and convenience like no other transceiver in the 2 meter world. This Maximizer's single-knob dial provides all 4 MHz in a flash, right to your single fingertip! The **IC-211** maximizes read-out speed with positively no time lag or backlash in display stability, even in modes using 100 Hz steps. The **IC-211**'s freewheeling dial, with its superb inertia clutch, is instantly coordinated with the high speed, computer circuitry controlled synthesizer's seven digit read-out using an optical chopper. There is absolutely no mechanical connection between the smooth, bearing mounted flywheel knob and the **two dual-tracking VFO's**, which come built into your **IC-211**.

- **Single knob frequency selection:** The **IC-211** is synthesized with convenient single knob frequency selection over the entire 4 MHz. No more fussing with two or more knobs just to check what is going on around the band. One easy spin of the dial does it all.
- **Two VFO's built in:** The second VFO, which is an optional tack-on with most other transceivers, is an integral feature in every **IC-211**.
- **Variable offset:** Any offset from 10 KHz through 4 MHz, in multiples of 10 KHz, can be programmed with the LSI synthesizer.
- **Remote programing:** The **IC-211** LSI chip provides for input of touch tone and programing data from an external source, such as the microprocessor controlled accessory which will also provide scan and other functions (available summer '78). Computer control from a PIA interface is also possible (data available on request).
- **FM stability on SSB and CW:** The **IC-211** synthesis of 100 Hz steps makes SSB as stable as FM. This extended range of operation is attracting many FM'ers who have been operating on the direct channels and have now discovered SSB.

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Maximize the new repeater band: both the **IC-211** and the **IC-245/255** operate the the new FCC repeater spectrum with no modification.

All ICOM radios significantly exceed FCC specifications limiting spurious emissions.

Specifications: ☐ Frequency Coverage: 144.00 to 148.00 MHz ☐ Modes: SSB (A3J), FM (F3), CW (A1) ☐ Supply Voltage: DC, 13.8V ± 15%; AC 117V ± 10% ☐ Size: 111mm(h) x 241mm(w) x 264mm(d) ☐ Weight: 6.8 Kg ☐ TX Output: A3J, 10W (PEP); A1 & F3, 10W ☐ Spurious Radiation: – 60 dB below Carrier ☐ Microphone Impedance: 600 Ohms ☐ Sensitivity: A3J & A1, 0.5 microvolt 10 dB S+N/N; F3, 0.6 microvolt for 20 dB quieting ☐ Spurious Response: –60 dB or better ☐ Synthesizer Frequency Range: 144.00 MHz to 148.00 MHz ☐ Synthesizer Step Size: 100 Hz or 5 KHz for SSB, 5 KHz for FM

Supplied with hand held microphone, AC cord, DC cord, fuses and owner's manual.

Specifications are subject to change without notice.

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Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CONTESTS

ARRL STRAIGHT KEY NIGHT

Complete rules in the June issue of *QST!* If no changes over last year's rules, contest runs full 24-hour period, 0000 GMT to 2400 GMT July 4. Use a straight key only! Suggested frequencies are 60 to 80 kHz up from bottom edges of 80-40-20 meter bands or 10 kHz up from bottom of Novice bands. Send "SKN" instead of RST during QSOs to identify stations working the contest. After the contest period, send a list of the stations worked plus your vote for the best "fist" heard (not necessarily worked) or most interesting QSO. All entries should be addressed to: ARRL, 225 Main Street, Newington CT 06111.

10-10 NET SUMMER QSO PARTY
Starts: 0000 GMT July 15
Ends: 2400 GMT July 16

Open to all amateurs, but only members are eligible for awards. All contacts to be made on 10 meters, any mode. A station may be counted only once.

EXCHANGE:

Name, QTH, 10-10 number. Be sure to log date and time of each contact!

SCORING:

1 point for each contact; add 1 point if with a 10-10 member. Maximum of 2 points per contact; no multipliers. Give name of your chapter.

AWARDS:

1st and 2nd place certificates to each US dist, KL7, KH6, and US Pacific Island, each VE dist, Central America and Caribbean, South America, Europe, Africa and S. Atlantic, Asia, Australia, New Zealand, and S. Pacific.

ENTRIES:

Members only—send log information to: Grace Dunlap K5MRU, Box 13, Rand CO 80743, no later than August 30. Results will be published in the Net Fall Bulletin.

VHF SPACE NET CONTEST
Contest period is from
6 pm Saturday, July 15 to
9 pm Sunday, July 16
YOUR LOCAL TIME!

This event commemorates the 9th anniversary of Apollo II, man's first landing and walk on the moon, with activity on 50, 144, 20 MHz, etc., in all modes *except repeaters.*

EXCHANGE:

Signal report and zip code or PO locations if out of country.

SCORING:

Each contact is worth 2 points. The same station may be reworked on a different mode for added 2 points, and reworked again on different bands for additional 2 points. Each different zip code worked is one multiplier with all out of country contacts using the PO location as a zip code. Scoring is total of all QSO points multiplied by the total of different zip codes and PO locations.

CATEGORIES:

Class 1—100 to 500 Watts; Class 2—25 to 100 Watts; Class 3—5 to 25 Watts; Class 4—1 to 5 Watts; Class 5—CW only with any power; Class 6—XYL only with any power; Class 7—club participation.

AWARDS AND ENTRIES:

Highest score in each category receives a trophy plaque; all second and third high scores will receive a space net certificate. Mailing deadline of logs is August 10. Mail all entries to: VHF Space Center, K4AWS, Box 15, Sumterville FL 33585. There will be a special bonus surprise for all stations working the space net center during the contest.

THE COLOMBIAN INDEPENDENCE DAY CONTEST

This activity commemorates the 167th independence anniversary and is intended to promote and increase the DX activity of HK radio amateurs. Entry classifications include: single-op/single band, single-op/multiband, and multi-op/multiband/one rig. Band used may be any amateur band from 80 to 10 meters, phone, SSB, or CW modes. Contest call is "CQ HK CONTEST."

EXCHANGE:

RS(T) plus 3-digit serial QSO number, HK station's RS(T) and HK prefix.

SCORING:

Each HK QSO counts 5 points. QSOs with another continent count 3 points. QSOs in same continent but different country are 2 points, and same country are 1 point each. Multiplier is total number of different countries worked on *all bands.* Final score is sum of QSO points on each band multiplied by the sum of different countries worked on each band.

AWARDS:

Sterling silver cup trophy to world winner of the contest; silver plates to continental winners and class winners.

RESTRICTIONS:

Minimum of 50 QSOs must be shown in logs to be eligible for any award. Only one contact per band with the same station will be permitted. No crossband or crossmode contacts. Club stations can only take part as multi-op/multiband/single transmitter class. Violation of the regulations of amateur radio in the country of the contestants, or the rules of the contest, or taking credit for incorrect QSOs or multipliers, or duplicate contacts in excess of 2% of the total made, will be deemed sufficient cause for disqualification. The LCRA Contest Awards Committee decision shall be final.

ENTRIES:

Logs must show date/time in GMT; keep separate log sheets for each band. Enter country only the first time it is contacted. Each entry must be accompanied by a summary sheet listing all scoring information. All logs must be postmarked no later than Sept. 30 and mailed to: LCRA—Concurso Independencia, C/O Contest Committee Manager, Apartado Postal 584, Bogota, Colombia, S.A.

RHODE ISLAND QSO PARTY
Contest Periods:
1700 GMT Saturday, July 22 to 0500 GMT Sunday, July 23
1300 GMT Sunday, July 23 to 0100 GMT Monday, July 24

Sponsored by the East Bay Amateur Wireless Association. RI stations work other RI stations and the rest of the world—others work RI only. The same station may be worked once per band and mode.

EXCHANGE:

RS(T), QTH—state, province, or country; RI send county.

SCORING:

RI stations score 2 points per QSO; RI Novice and Tech stations score 5 points per QSO. Others score 2 points per RI QSO and 5 points per QSO with RI Novice or Tech. RI Novice and Tech sign with /N or /T to designate license class. RI multiply total QSO points by the number of RI counties, states, provinces, and DX countries worked. Others multiply total QSO points by the number of RI counties worked (5 max.). All stations—score 10 points for QSO with multi-op station operated by club members N1RI.

FREQUENCIES:

Phone—3920, 7260, 14300, 21360, 28600, 50.3, 145.1.

CW—1810, 3550, 3710, 7050, 7110, 14050, 21050, 21110,

CALENDAR

July 1-2*	Seven Land QSO Party
July 4	ARRL Straight Key Night
July 8-9	IARU Radiosport Competition
July 15	Colorado YL Field Day
July 15-16	10-10 Net Summer QSO Party
	VHF Space Net Contest
	Colombian Independence Day Contest
July 22-24	Rhode Island QSO Party
July 29-31	CW County Hunters Contest
	New Jersey QSO Party
Aug 19-20	SARTG Worldwide RTTY Contest
Sept 9-10	ARRL VHF QSO Party
	Pennsylvania QSO Party
Sept 16-18	Washington State QSO Party
	Scandinavian Activity Contest—CW
Sept 23-24	Scandinavian Activity Contest—SSB
	Delta QSO Party
Oct 7-8	VK/ZL/Oceania DX Contest—Phone & RTTY
Oct 14-15	VK/ZL/Oceania DX Contest—CW
	ARRL CD Party—CW
Oct 21-22	ARRL CD Party—Phone
Nov 4-5	ARRL Sweepstakes—CW
Nov 11	OK DX Contest
Nov 18-19	ARRL Sweepstakes—Phone
Dec 2-3	ARRL 160 Meter Contest
Dec 9-10	ARRL 10 Meter Contest

* = described in last issue

28050, 28110.

Use of FM simplex is encouraged, but no repeaters!

AWARDS:

Certificates will be awarded to the top scoring station in each RI county, state, province, and DX country; the top scoring Novice and Technician station in each RI county and state; and the ARC in each state, province, and DX country that submits the highest aggregate score (min. 3 logs per club).

ENTRIES:

Logs must show date/time in GMT, call, exchange, band, and mode. On a separate sheet show name, call and mailing address, club affiliation, if any, total QSO points, multiplier, claimed and final scores. Send logs and summary postmarked no later than Aug. 31 to: East Bay Amateur Wireless Assoc., PO Box 392, Warren RI 02885. Include an SASE for results.

CW COUNTY HUNTERS CONTEST

Starts: 0000 GMT July 29
Ends: 0200 GMT July 31

The CW County Hunters Net invites all amateurs to participate in the 1978 CW County Hunters Contest with all mobile and portable operation in less active counties welcomed and encouraged. General call is "CQ CH." Stations may be worked once per band and again if the station has changed counties. Portable/mobile stations changing counties during the contest may repeat contacts for QSO points. Stations on county lines give and receive only one QSO number per contact, but each county counts for a multiplier.

EXCHANGE:

QSO number, category (P = portable, M = mobile), RST, state, province, or country, and county if US.

FREQUENCIES:

3575, 7055, 14070, 21070, 28070. It is requested that only P or M category stations call CQ or QRZ on 40 meters below 7055 and on 20 meters below 14070, with all stations spreading out above those frequencies.

SCORING:

QSOs with fixed stations count 1 point, portable/mobile stations = 3 points; multiply QSO points times number of US counties worked for final score. Mobiles/portables calculate their score on the basis of total contacts within a state.

AWARDS:

Certificates awarded to highest scores in three categories: F—highest fixed or fixed portable in each state, province, and country with 1,000 or more points; P—highest station operating portable (not normal point of operation) with 1,000 or more points; M—highest mobile in each state operating from 3 or more counties with a minimum of 10 QSOs per county.

Trophies to highest single-operator station in categories P and M in the USA. Additional awards where deemed appropriate.

ENTRIES:

Logs must show category, date/time in GMT, station worked, exchanges, band, QSO pts, location, and claimed score. All entries with 100 or more QSOs *must include a check sheet* of counties worked or be disqualified from receiving awards. Enclose a large SASE if results are desired. Logs must be postmarked by Sept. 1 and sent to: CW County Hunters Net, c/o Jeffrey P. Bechner W9MSE, 673 Bruce St., Fond du Lac WI 54935.

NEW JERSEY QSO PARTY

Contest Periods:
2000 GMT Saturday, July 29 to 0700 GMT Sunday, July 30
1300 GMT Sunday, July 30 to 0200 GMT Monday, July 31
(Please note the date change from the original announced weekend)

Sponsored again by the Englewood ARA, all amateurs the world over are invited to take part in the 19th annual event. Phone and CW are considered the same contest. A station may be contacted once on each band; phone and CW considered separate bands, but CW contacts may not be made in phone band segments. NJ stations may work other NJ stations. General call is "CQ NJ" and NJ stations are requested to identify themselves by signing "DE NJ." Stations planning active participation in NJ are requested to advise the EARA by July 8 of their intentions so that plans can be made for full coverage from all counties. Portable and mobile operation is encouraged.

EXCHANGE:

RS(T), QSO number and ARRL section or country, NJ county for NJ stations.

FREQUENCIES:

1810, 3535, 3905, 7035, 7135, 7235, 14035, 14280, 21100, 21355, 28100, 28600, 50-50.5, and 144-146. Suggest phone activity on the even hours, 15 meters on the odd hours (1500 to 2100 GMT), 160 meters at 0500 GMT.

SCORING:

Out-of-state stations multiply number of QSOs with NJ stations times the number of NJ counties worked (21 max.). NJ stations: W-K/VE-VO count 1 point, DX count 3 points per QSO. Multiply total number of QSO points times the number of ARRL sections (including NNJ and SNJ—max. 75). KP4, KH6, KL7, KZ5, etc., count as 3-point DX contacts and as section multipliers.

AWARDS:

Certificates will be awarded to the first place station in each NJ county, ARRL section, and country. In addition, a second place certificate will be awarded when 4 or more logs are received. Novice and Technician certificates will be awarded as well.

ENTRIES:

Logs must show GMT date and time, band, mode, and be received not later than Aug. 26. The first contact for each claimed multiplier must be indicated and numbered and a checklist of contacts and multipliers should be included. Multi-op stations should be noted and calls of participating operators listed. Logs and comments should be sent to: Englewood ARA, Inc., PO Box 528, Englewood NJ 07631. A size #10 SASE should be included for results.

COLORADO YLs SYLVER DOLLAR AWARD

Contact and QSL 5 Colorado YL members; DX only need 3. Award has pictures of station worked with endorsement credit and pictures for additional contacts. Send list of contacts made and QSLed showing log data along with 50¢; DX send 2 IRCs. For endorsements, send as above with 10¢ and SASE. Mail to Club Station Trustee, WAØESM, 15715 N. 107th, Longmont CO 80501.

RESULTS

RESULTS OF THE 10-10 INTERNATIONAL NET WINTER QSO PARTY FEB. 11-12, 1978

Top Ten

W7ZR	1391/2497
VE7CMN	1313/2334
K7CZ	1035/1793
WB7ERF	924/1651
VE7CML	899/1609
WB6JPY	870/1583
WB7BFK	818/1493
K7PVZ	817/1480
K3LYW	833/1442
KØGU	859/1433

Top Ten Chapters

Cal. Bay Area	11293/21479
So. N.E. Nutmeg	11447/21459
Colorado	11475/20851
Gateway	8748/16474
Sky Blue Waters	7848/14838
White House	7707/14024
C.A.T.T.	6387/11829
Minute Man	4213/7825
Grand Canyon	3645/6477
King Salmon	3378/6101

U.S. District Leaders

1. W1GUC	509/909
2. K9EGA/2	836/1389
3. K3LYW	833/1442
4. WB4NDX	605/1025
5. WA5JDU	600/1059
6. WB6JPY	870/1583
7. W7ZR	1391/2497
8. WB8EDG	625/1097
9. WB9WFZ	314/565
0. KØGU	859/1433
KG6. KG6JIA	949/1196
KH6. WB4OGP/KH6	432/746
KL7. KL7GRP	292/533

Multi-Op Stations

W8WD	808/1351
W9NIN	617/1077
VE2DZE/VE3	196/360

Canadian and DX Leaders

VE1.	VE1ASU	176/313
VE2.	VE2DZO	381/641
VE3.	VE3IDJ	166/310
VE4.	VE4OY	300/561
VE5.	VE5QY	205/373
VE6.	VE6ATT	246/441
VE7.	VE7CMN	1313/2334
Cen. America	TI2NA	588/1056
So. America	LU7FAG	163/386
Europe	DK5UG	219/410
Africa	EL2AK	74/138
Asia	JA3XOG	215/401
ZL-VK	ZL3SW	144/269

Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

SUN DAY IN THE SOUTHLAND

How did you celebrate Sun Day? A number of Los Angeles area amateurs went all out to make Sun Day in L.A. one to be remembered. The WR6AUG Solar Power Amateur Radio Repeater Group, the Canyon Repeater Association, and a number of other area amateurs joined forces, and through their efforts Los Angeles Mayor Tom Bradley was treated to his first solar-powered autopatch telephone conversations.

The idea of demonstrating a solar-powered amateur radio telephone link was conceived by the Atlantic Richfield Solar Technology Company and the WR6AUG Solar Power Amateur Radio Repeater Group. For the demonstration, Atlantic Richfield provided the solar panels, Pacesetter Systems, Inc., provided all necessary electronic test equipment, and the Canyon Repeater Association of Sylmar, California, made available the WR6AWQ 220 MHz autopatch repeater. WR6AWQ is located atop a "bump" known as Loop Canyon Summit (4500' plus) and has the ability to reach almost anywhere. This ability was to be well tested during the Sun Day demonstration.

The plan seemed simple enough. Two telephone calls were to be placed which would permit Mayor Bradley to speak with Deputy Secretary of Energy John O'Leary and Congressman Ryan, Chairman of the Congressional Subcommittee on Energy and Energy Resources, both in Washington DC. To be sure that the demonstration could take place, a test run was made on the Monday prior to the actual event by WR6AUG trustee Dr. Joseph Schulman K6BWA. For the test, a 220 MHz Wilson hand-held was fitted to an external Larsen 5/8-wave antenna. All seemed to work well. Looked like a snap, according to Joe. Then, on Tuesday evening when a full duplex test involving the public address system was attempted, the fickle finger of fate struck. The "path" from downtown LA at the park across from City Hall to Loop Canyon Summit had gone sour. While the repeater was only about 25 miles from the demonstration site, rf in both directions had to cross some rugged terrain which included a few "bumps" that cast rf shadows of the worst kind. To remedy this situation, two steps were taken. First, Jim Hendershot WA6VQP, trustee of WR6AWQ, drove up to the Loop Canyon site at a bit past midnight and disabled AWQ's final power amplifier. This was to minimize any desensitization to the repeater's receiver. Secondly, the Wilson/Larsen combo was replaced by a Midland 13-509 10-Watt radio and an 11-element Hy-Gain beam. Another 13-509 was jeeped (wired directly) to the PA system so that both sides of the conversation could be heard at once by the spectators . . . full duplex!

To add to all the rest of the problems, when Sun Day morning came, it brought with it a distinct lack of California's most notable commodity, sunlight. Lou WA6EPD, Roy W6TSI, and Norm WB6DGF formed an instant antenna-pointing committee, and after a number of tests found a way to make the path cooperate. Somehow it all came together, and at the appointed hour the calls were placed through the WR6AWQ autopatch from a Midland 13-509 at LA City Hall Park operating off power provided by Mother Nature herself.

It should also be mentioned that there were contingency plans just in case the path to Loop Canyon had gone completely out. Both the WR6AYY and WR6ABC repeaters, located in the nearby Hollywood hills, were on "standby alert." While their facilities were not needed as it turned out, it was comforting for all to know that they were there just in case. AWQ, at a far greater distance and with its circularly-polarized antenna array, came through and made the overall demonstration far more dramatic, but none of this would have happened at all had not a group of amateurs from many repeaters gotten together and worked as a team to make everything tick like a well-oiled clock. The Mayor was happy, the people in Washington were happy, and once again amateurs had proved that anything could be done.

THANK YOU, OTTO; WELCOME, DENNIS

On or about June 1, 1978, Otto Arnosht WA6RMX will step down from the post of SCRA Two Meter Technical Committee chairman, one which he has held for the past year and a half. As a research psychologist, Otto brought a new dimension to the world of voluntary frequency coordination: knowledge of the science of people. Otto has become known as the "peace maker" around these parts, and in the time he has served as chairman, he has never had a problem for which he and his committee could not find a solution. Otto will be missed by many of us who have learned much by watching him. He resigned in order to attend to other pressing matters outside amateur radio. He will be missed. The SCRA has announced that Dennis Romack WA6OYI will be the new Two Meter Technical Committee chairman. Dennis is from San Diego and is best known in amateur circles as Marketing Vice President of DSI. Dennis has in the past served on the Board of Directors for the San Diego Amateur Repeater Association (SANDRA), and is currently president of the 220 Club of San Diego, one of the nation's largest organizations dedicated to furthering the development of 220 MHz. LW joins with the rest of the southern California amateur community in welcoming Dennis to his new post.

VHF-UHF COORDINATION AND TECHNICAL SYMPOSIUM

TENTATIVE AGENDA

I. INTRODUCTORY SESSION: Bob Buaas, 9:00 to 10:00 AM September 23,1978

A. Welcoming
B. Introduction of special guests and Session leaders.
C. Overview of the sessions that will be running con-currently throughout the day

II. BREAK: Coffee and snacks provided by _____Club. 10:00 to 10:20

III. PARALLEL SESSIONS RUNNING UNTIL LUNCH AND AFTER LUNCH to 4:30 PM

COORDINATION SESSION
Chaired by Bill Pasternak

A. National Input from represented areas of U.S. as to how Coordination is now done.

B. Protection of Non-Relay Interests
1) Sideband
2) Satellite
3) FM Simplex
4) Weak Sig., EME, ATV, etc.

C. Enforcement of Coordination
1) Amateur - DFing
2) Peer Pressure
3) FCC

D. Looking at Spectrum Management
1) Present uses of spectrum
2) How could spectrum space be better conserved?
3) Looking 10 years ahead

NON-RELAY COMMUNICATIONS SESSION
Chaired by Lou Anxiaux

A. Simplex: Sideband & FM

B. EXOTIC MODES: EME, OSCAR, ATV, RTTY, CPUPUTERS

REPEATER SESSION
Chaired by Bob Thornburg

A. Repeater Techniques
1) Circular Polarization
2) Beeps for re-set
3) Hi/Low beeps
4) Semi tone squelch
5. Specialized: RTTY, ATV, Sideband, etc.

B. Repeater User Control
1) Open vs Closed Repeaters
2) Open PL
3) Jamming, Bad Language, Offensive interjections
4) Westlink
5) Autopatch Control

C. Remote Control Techniques
1) CACTUS: What is it?
2) Telemetry
3) HF Tranceivers//Antennas
4) Simplex Autopatch
5) Microprocesser Control

D. Advances in DF Techniques
1) T-Hunts
2) Commercial units
3) Amateur built units

THE BIG MEETING

I recently promised that as soon as a tentative agenda for the September 23, 1978, National Voluntary Coordination, Band Planning, and Technical Advances Seminar in San Diego was available, I would bring it to you. If, after reading it, you wish to take part, drop a note to SCRA, PO Box 2606, Culver City CA 90230, for a complete information packet on the meeting and the convention it is a part of. Hope to see you in San Diego.

Ham Help

I'm interested in hooking up a low-frequency multiband antenna that operates efficiently and effectively on a motor home. I would like the system to be usable, if possible, while in motion. Any help would be appreciated.

James V. Devilbiss WA3FUJ
915 Pine Ave.
Frederick MD 21701

Can anyone loan (to be copied and returned, with postage paid both ways by me) an instruction book and/or schematics for a Knight T-60 transmitter and a Heathkit HR-10B receiver? Any help concerning the loading of the Knight T-60, which is equipped with a relative power meter, will be especially appreciated.

Edwin R. Lappi WD4LOO
109 Lynn Drive
Carrboro NC 27510

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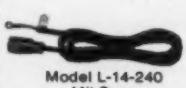

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RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

The more observant among you have probably noticed that there is a computer listing printed in this month's column. This is the implementation of the simple Baudot receiving program outlined last month. I realized that, although RTTY and computers are natural partners, some of you are not at all interested in reading any more about microprocessors. You all may skip to the end of the column, where some questions from readers are answered. For the bulk of you, here we go!

The program, as written, is configured for the SWTPC 6800 computer, and resides in RAM at addresses 0020H to 015AH. (Throughout this article, hexadecimal numbers will be identified with the suffix "H", as 1234H. Numbers without an "H" are decimal.) It assumes that a parallel interface (MP-L or MP-LA PIA card) is located at port #7, address 801CH, and that the B side is configured as an input. Two routines from MIKBUG, or SWTBUG, the resident ROM monitor, are called. OUTEEE, at E1D1H, puts the data in the A accumulator out to the terminal as an ASCII character. PDATA, at E07EH, puts the data pointed to by the index register out to the terminal as an ASCII string, until an EOT (04) character is read, which terminates the routine. Users of other 6800 systems may implement the program by changing necessary addresses as needed to suit their systems.

As described last month, the required input is to bit 0 of the PIA, side B, as written. A reed relay inserted in the loop and connected to the PIA, with an appropriate pull-up resistor as outlined last month, is one way to interface a TTY loop. Users of demodulators which have an RS-232 output, such as the ST-6, may connect them directly. With the ST-6, for example, the appropriate line is labeled the "FSK" output, and is standard RS-232C logic. It measures about five volts negative on mark and five volts positive on space. This is exactly what we want; no pull-up or other components are required.

Examining the program, we find that the first 256 bytes are used for tables, strings, and storage. The Letters and Figures tables carry the Baudot data in the binary progression detailed in "RTTY Loop" last July. Remember, however, that the data is complemented. That is, while "R" is 01010, binary, the encoded table form is 10101, with marks and spaces reversed. This is 15H, and if you add that to the starting address of the Letters table, 0020H, you get 0035H. The data at 0035H is 52H, and that is ASCII for "R". Okay? That's how the table works.

The main program starts at 0100H. After setting up the

```
00010                    NAM   BAUDOT 3.0
00020                    OPT   O

00040                ********************************
00050                * BAUDOT RECEIVING PROGRAM     *
00060                *   FOR THE SWTPC 6800         *
00070                *  VER 3.0 -- 18 APR 78        *
00080                *  MARC I. LEAVEY, M.D.        *
00090                *        WA3AJR                *
00100                ********************************

00120                ****** EXTERNAL ROUTINES
00130       E1D1     OUTEE  EQU   $E1D1
00140       E07E     PDATA  EQU   $E07E
00150       801E     PIADB  EQU   $801E     * PIA DATA REG B - PORT 7
00160       801F     PIACB  EQU   $801F     * PIA CNTL REG B - PORT 7
00170       A043     PDCTR  EQU   $A043     * PROGRAM COUNTER

00190                ****** TABLES AND STORAGE
00200                * THE ASCII ENCODED DATA
00210                * IS IN BAUDOT ORDER IN
00220                * TWO TABLES: LTRS AND
00230                * FIGS. NULL IS USED FOR
00240                * CHARACTERS NOT DECODED
00250                ******
00260 0020           LTRTBL ORG   $20
00270 0020 7F              FCB   $7F      (LETTERS)
00280 0021 4B              FCC   \KCUR\
      0022 51
      0023 55
00290 0024 00              FCB   0        (FIGURES)
00300 0025 4A              FCC   \JWAGPYSBDZEVCPIONL\
      0026 57
      0027 41
      0028 53
      0029 46
      002A 59
      002B 53
      002C 42
      002D 44
      002E 5A
      002F 45
      0030 56
      0031 43
      0032 50
      0033 49
      0034 47
      0035 52
      0036 4C
00310 0037 00              FCB   0        (LINE FEED)
00320 0038 4D              FCC   \MHS\
      0039 48
      003A 53
00330 003B 20              FCB   $20      (SPACE)
00340 003C 47              FCC   \GM\
00350 003D 00              FCB   0        (CAR RET)
00360 003E 54              FCC   \T\
00370 003F 00              FCB   0        (BLANK)

00390 0040 7F        FIGTBL FCB   $7F      (LETTERS)
00400 0041 58              FCC   \X(17\
      0042 31
      0043 37
00410 0044 00              FCB   0        (FIGURES)
00420 0045 57              FCC   \W2-/16\
      0046 32
      0047 2D
      0048 2F
      0049 31
      004A 36
00430 004B 07              FCB   7        (BELL)
00440 004C 37              FCC   \75"3':0844)\
      004D 35
      004E 22
      004F 33
      0050 3A
      0051 3A
      0052 30
      0053 38
      0054 26
      0055 34
      0056 29

00450 0057 00              FCB   0        (LINE FEED)
00460 0058 4E              FCC   \NJ9 3\
      0059 2C
      005A 23
      005B 20
      005C 39
00470 005D 00              FCB   0        (CAR RET)
00480 005E 35              FCC   \5\
00490 005F 00              FCB   0        (BLANK)

00510 0060 0D        CRLFST FCB   $D,$A,$15,0,0,4
      0061 0A
      0062 15
      0063 00
      0064 00
      0065 04

00530 0066 0002      XSTORE RMB   2

00550                ****** MAIN PROGRAM STARTS
00560                ****** HERE
00570 0100                  ORG   $100
00580 0100 8E A070 START    LDS   #$A070   * SET UP STACK
00590 0103 86 04            LDA A #$4      * INITIALIZE THE PIA
00600 0105 B7 801F          STA A PIACB    *   AS AN INPUT
00610 0108 B6 801E SLOOP    LDA A PIADB    * L O O P   UNTIL
00620 010B 4D               TST A          *   START PULSE
00630 010C 27 FA            BEQ   SLOOP    *     IS LOCATED
00640 010E BD 44            BSR   ASEC10   * DELAY 1/2 PULSE
00650 0110 C6 05            LDA B #$5      * SET UP COUNTER
00660 0112 4F               CLR A          * CLEAR ACCUMULATOR A
00670 0113 48         CLOOP ASL A          * SHIFT ACCUM-A LEFT ONE
00680 0114 BD 3B            BSR   ASEC20   * DELAY ONE PULSE
00690 0116 B6 801E          LDA A PIADB    * GET THE DATA INTO "A"
00700 0119 5A               DEC B          * DECREMENT THE COUNTER
00710 011A 5D               TST B          * COUNT = 0 ?
00720 011B 26 F6            BNE   CLOOP    * NO -> GET NEXT BIT
00730 011D 81 1D            CMP A #$1D     * IS IT BAUDOT CAR-RET?
00740 011F 27 28            BEQ   CRLF     * YES. DO A CR/LF
00750 0121 81 04            CMP A #$4      * IS IT BAUDOT FIGS?
00760 0123 27 0F            BEQ   FIGS     * YES. SHIFT TABLES
00770 0125 81 00            CMP A #$0      * IS IT BAUDOT LTRS?
00780 0127 27 04            BEQ   LTRS     * YES. SHIFT TABLES
00790 0129 81 1B            CMP A #$1B     * IS IT BAUDOT SPACE?
00800 012B 26 10            BNE   GETCHR   * NO. PUT IT OUT NOW.
00810 012D CE 0020 LTRS     LDX   #LTRTBL  * LOAD INDEX WITH LTRS TABLE
00820 0130 DF 66            STA   XSTORE   * STORE THAT AT MARKER
00830 0132 20 09            BRA   GETCHR   * NOW GO PUT IT OUT
00840 0134 CE 0040 FIGS     LDX   #FIGTBL  * LOAD INDEX WITH FIGS TABLE
00850 0137 DF 66            STA   XSTORE   * STORE THAT AT MARKER
00860 0139 3D 19            BSR   ASEC10   * DELAY 1/2 PULSE
00870 013B 20 CB            BRA   SLOOP    * WAIT FOR NEXT INPUT
00880 013D B7 0143 GETCHR STA A LOCATE+1 * SET POINTER FOR TABLE
00890 0140 DE 66            LDX   XSTORE   * GET CURRENT TABLE INDEX
00900 0142 A6 00      LOCATE LDA A X       * LOAD ACC-A AT POINTER
00910 0144 BD E1D1          JSR   OUTEE    * PUT OUT TO TERMINAL
00920 0147 20 BF            BRA   SLOOP    * START ALL OVER AGAIN

00940                ****** SUBROUTINES
00960 0149 CE 0060 CRLF     LDX   #CRLFST  * INDEX TO CR/LF STRING
00970 014C BD E07E          JSR   PDATA    * PUT OUT TO TERMINAL
00980 014F 20 A7            BRA   SLOOP    * RETURN TO WAIT ROUTINE

01000 0151 8D 01      ASEC20 BSR   ASEC10   * TWO ASEC10'S=ASEC20
01010 0153 01               NOP
01020 0154 CE 0430 ASEC10 LDX   #$430    * ADJUST DELAY FOR BEST COPY
01030 0157 09         DLOOP DEX
01040 0158 26 FD            BNE   DLOOP
01050 015A 39               RTS

01070                ****** PROGRAM COUNTER SET-UP
01080 A043                  ORG   PDCTR
01090 A043 0100             FDB   START
01100                       END

TOTAL ERRORS 00000

AFTER PASS : 1P.2P.3..2T
```

stack and initializing the PIA, the program loops while waiting for the start pulse, which is always a space. Once located, the program loads the A accumulator with the five data bits, as detailed last month. That data is loaded into an offset located at 0143H, which serves as the pointer for the appropriate table. The current table in use is stored at XSTORE: two bytes located at 0066H and 0067H. After the data is acquired, but before it is put out, several special cases are tested for. A 1DH is carriage return, and causes a branch to a routine to put out a carriage return, line feed string which can be customized to the system. Here, a 15H is included to perform an erase to the end of the line. Receipt of LTRS or FIGS (00H or 04H) causes the data at XSTORE to be updated accordingly, and SPACE (1BH) forces Letters case, a software "downshift-on-space." Because of the special routines, several codes appear as 00 in the tables. FIGS, LINE FEED, and CARRIAGE RETURN are all ignored in the table decoding.

The delay routines, MSEC20 and MSEC10, depend on a counting loop from 0154H to 0159H. The DEX (Decrement Index Register) instruction requires four machine cycles, as does the BNE (Branch If Not Equal). Thus, the set of two instructions requires eight cycles per loop. If the cycle time is 1.1 μs, as with the SWTPC 6800, the execution of this loop 480H (1152) times would result in a 10.1376 ms delay—close enough to 11 ms when allowing for the rest of the program time. However, users of different systems may find adjustment of this value necessary to produce good copy, and it is suggested that it be used much as a Range adjustment on an old Model 15. Take the minimum and maximum values which give good copy and find the mean. Watch out for the hexadecimal arithmetic! Place the determined value at 0155H as the optimum delay value.

To use the program, set the program counter to 0100H and hit "G". With input on the PIA, the terminal should follow the incoming RTTY signal. Because the entire character should be completed *during* the STOP pulse, a terminal running at 300 baud works best. For faster terminals, an additional delay is needed to insure that when the character is finished, the STOP is being sent.

A note received from Norm Monro K4FRY touches on his hopes of putting the Kenwood 599D pair on RTTY. Any reader with experiences along these lines is invited to write Norm or this column. Another Kenwood owner, Manuel Marrero KP4EHE, Box 1828, Aquadilla PR 00603, needs help putting his Kenwood TS-520S on RTTY. I'm including Manuel's complete address to help those who might want to drop him a line.

In general, any information pertaining to putting this type of equipment on RTTY is welcome, and will be included in future columns, as received.

Another reader, David Baxter WA4JHH of Grenville KY, writes, in part:

"I have a Knight R-100A general coverage receiver. Is it possible to copy TTY with this receiver? What would be the most economical printer I could obtain ... that I could later use ... on the ham bands?"

First off, David, my recollection of the R-100A is that it was a budget receiver sold about ten years ago by Allied. The ones I saw were quite able to do a reasonable job copying sideband, and thus should be able to copy TTY without too much trouble. What you are looking for most is *stability*. After warming up, drifting 50 Hz or so would be intolerable. This is roughly the same degree of stability demanded for SSB, so if it is adequate for one, it should do for the other.

As to the printer, the most realistic answer is anything you can get that you can afford that works! I suspect that if you scout around at hamfests and ads, you may be able to pick up a Model 15 for less than $50. This is an entirely satisfactory printer, and can do quite well for many years. After you look around a bit, and perhaps after this column lets the Greenville community know you are looking, who knows what bargains you will stumble upon.

In future months, we will delve into some specific machines and phenomena, and answer more readers' questions. Drop me a line; let me know what *you* would like to see.

Corrections

You recently published an article of mine in the April issue entitled, "Build this Digital Ball Game." It has been brought to my attention that the schematic printed in the article has a couple of problems. On IC2, ground connections should be 2, 3, 6, 7, and 10. On IC3, the LEDs should be inverted and their anodes connected to +5 V. I can only attribute the error to my "newness" to digital electronics at the time of its writing. In the subsequent proofreadings, the error went unnoticed. I am sorry.

Ralph A. Giffone N2RG
Brooklyn NY

Please note a few corrections to my "FCC Math," May issue, p. 18 and p. 130:

(1) On p. 18, in the left-hand column, second paragraph from bottom, four lines down, "and that is about 9.2 x 10^1 or 92" should read "and *the square root* of that is about 9.2", etc.

(2) In the same column, last paragraph, fifth line down, there is a problem with "(100/10)·(100/10) = 10". The dot should be down, a period, not a multiplication as indicated.

(3) And, on p. 130, in the left-hand column, the square root sign in that asterisked footnote should have continued on over the numbers following the minus sign in both cases.

John Leahy WB6CKN
Gonzales CA

Two versions of the MK-III were constructed before I submitted the article ("Build This Excitingly Simple Receiver") which was published in the May issue on page 76. One version had the bias resistors for the MFE521 gate #1 (2.2k and 4.7k) connected as shown in the schematic, and the other had them connected to the bottom end of the secondary of T1. Unfortunately, I mixed them up and the printed circuit layout is for the latter method—it does not match the schematic. The receiver works equally well with either method, but I prefer the circuit incorporated in the printed circuit layout.

A 10 uF tantalum bypass capacitor should be shown on the schematic from the 7-volt line (regulated) to ground. It is incorporated in the printed circuit.

Ray Megirian K4DHC
Deerfield Beach FL

OSCAR Orbits

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

Oscar 7 Orbital Information

Orbit	Date (July)	Time (GMT)	Longitude of Eq. Crossing °W
16579 Bbn	1	0134:12	81.6
16591 Abn	2	0033:32	68.4
16604 Bbn	3	0127:50	80.0
16616 Bbn	4	0027:10	64.9
16629 Abn	5	0121:27	78.5
16641 Bbn	6	0020:48	63.3
16654 Bbn	7	0115:05	76.9
16666 Abn	8	0014:26	61.7
16679 Bbn	9	0108:43	75.3
16691 Bbn	10	0008:04	60.2
16704 Abn	11	0102:21	73.8
16716 Bbn	12	0001:41	58.6
16729 Bbn	13	0055:59	72.2
16742 Abn	14	0150:16	85.8
16754 Bbn	15	0049:36	70.6
16767 Bbn	16	0143:54	84.2
16779 Abn	17	0043:14	69.1
16792 Bbn	18	0137:31	82.7
16804 Bbn	19	0036:52	67.5
16817 Abn	20	0131:09	81.1
16829 Bbn	21	0030:30	66.0
16842 Bbn	22	0124:47	79.5
16854 Abn	23	0024:08	64.4
16867 Bbn	24	0118:25	78.0
16879 Bbn	25	0017:45	62.8
16892 Abn	26	0112:03	76.4
16904 Bbn	27	0011:23	61.3
16917 Bbn	28	0105:41	74.9
16929 Abn	29	0005:01	59.7
16942 Bbn	30	0059:18	73.3
16955 Bbn	31	0153:36	86.9

New Products

TELEX'S NEW PROCOM ELECTRET MIKES

I recently received two of Telex's new electret hand-held mikes, a ProCom I (which they recommend for use with the popular 2 meter FM transceivers), and a ProCom II (recommended for SSB operation). Replacing the original equipment mikes on my HF band and 2 meter transceivers with the ProComs has proved to be a smart move. Signal reports indicate that both mikes produce excellent speech quality and improved readability under difficult conditions.

The ProCom I and II are amplified microphones using electret elements. The amplifier in both mikes is powered by a 1.5-volt alkaline battery or by a 1.4-volt mercury battery. Amplifier gain is fixed in the ProCom I and adjustable in the ProCom II.

If you're considering a hand-held mike for a new rig or to replace an existing mike, you could be doing yourself a favor by trying one of the ProCom models. The mikes are light and fit comfortably in the hand, something that unfortunately can't be said for all hand-helds.

While the ProCom mikes do not incorporate noise cancelling, they do an excellent job in situations where there is typically a high noise level to contend with. For example, using the ProCom I for 2 meter mobile operation not only produced excellent speech quality, but also there was negligible pickup of road and wind noise.

The ProCom I was clearly superior in terms of overall performance, particularly in respect to speech quality and noise pickup, when compared to the original equipment mike it replaced.

On-the-air tests of the ProCom II were made on SSB on several of the HF bands using no more than 200 Watts and simple dipole antennas. The results were very favorable and any notions I might have had about the unsuitability of preamplified mikes were promptly dispelled after the first half dozen or so contacts. While signal strength reports were often as low as two or three, readability was consistently Q5 unless or until someone dropped a hefty signal on top of mine.

The ProCom I with fixed level output has a suggested retail price of $19.95. The ProCom II features a variable gain control and sells for $29.95. For further information, contact *Telex Communications, 9600 Aldrich Avenue South, Minneapolis MN 55420.*

Morgan W. Godwin W4WFL
Peterborough NH

STUART TOWER/TUNER

The Stuart Tower/Tuner is a modern rf matching device designed to match virtually any antenna tower system to 50-Ohm coax. It is currently available in two models: the 40 and 80 meter model (#4080), and the 80 and 160 meter model (#8160).

Each system comes complete with the following:

Tower/Tuner matching device: This device matches nominal 50-Ohm coax to the lower portion of a vertical tower, pole, or other object of similar shape. Rf radiation is then emitted from, and received by, the entire tower-beam/quad system. The device is housed in an all-aluminum box which has been sealed by mechanical means as well as a chemical sealer to provide a weatherproof enclosure. The box is then painted "communications gray" with an epoxy-based paint to give a truly attractive and mar-resistant finish. All tuning shafts are rubber sealed to present an effective moisture barrier.

All outside connections are made through technically-correct hardware which is sealed by the best sealant available.

In addition, all hardware necessary to mount the Stuart Tower/Tuner on almost any standard tower is supplied. The hardware supplied is either stainless steel or aluminum depending on the usage.

The horizontal support members are made of aluminum to minimize corrosion as well as to enhance the already tidy looks of the Stuart Tower/Tuner.

The hardware provided will accommodate mounting on either vertical or horizontal members of the tower.

The Stuart Tower/Tuner has been tested on towers from 35 to 100 feet in height supporting both beams and quads. Rotor cables and existing coaxial lines have not interfered with performance.

In our testing, the Stuart Tower/Tuner has *not* ever required the use of a radial system at the base of the tower to give both a good swr and excellent signal reports.

Tuning of the system is a simple direct procedure. In most cases, one setting of the tuning knobs will cover either 80 CW, 75 phone, or the entire 40 meter band or the entire 160 meter band, depending on which model you have, with an swr of less than 2:1.

Stuart Electronics provides a 30-day money-back trial period. If you are not satisfied, you may return it within 30 days for a full refund. The Stuart Electronics Tower/Tuner is guaranteed for a period of one year from date of purchase. If anything goes wrong with the unit within that time, simply return the matching device prepaid with proof of purchase. They will take whatever steps are necessary to restore your Tower/Tuner to new specs and return it to you prepaid.

The Stuart Tower/Tuner is available from Stuart Electronics for $129.95 including shipping. To order, call (216)-798-9431, or mail order to *Stuart Electronics, 578 Kennedy Road, Akron, Ohio 44305.*

Telex's electret microphones, ProCom I and ProCom II.

THE GENAVE GTX-4

Darned if Genave hasn't come up with a surprising little hand transceiver in their GTX-4. The "4" stands for the four crystal-controlled channels it can handle. Considering the $200 price tag and the fact that it is made in the U.S., the unit is astounding.

When you open the rig up to insert the six nicads, you'll be pleased to see that the interstices look nothing like a Motorola HT-220, even though the whole unit is about the same size as the 220 Slimline. I always remember Mr. Inoue, the president of Icom, when he opened my HT-220 and looked inside for the first time—there was a long gasp when he saw the micro components used . . . "We couldn't build *that!*" The Genave rig uses normally miniature components, not the almost invisible micro stuff Motorola uses which has a lot to do with the fascinating price of the 220. This also makes it a lot more practical to contemplate servicing the Genave. You need a microscope and very, very steady hands for the 220 . . . and probably a 1/10th Watt iron with a pin for a tip.

Genave has taken a leaf out of the Motorola book and put in a separate microphone instead of using the speaker as the mike. Motorola learned that, so you'll find the separate mike on their later units. It makes for much better voice quality.

One feature that I like infinitely better than the 220 is the Genave charging plug. They use the same system as is used on calculators such as the SR-52 with a small mike plug coming from the 6 V 47 mA charger. I travel a lot and like to take my HTs with me . . . and while they aren't so bad on space, those great big charging stands take up a lot of suitcase room and have made one arm a half inch longer than the other already. A couple little calculator charging units fit in anywhere and do the job fine, with no worry about whether the rig is sitting on the pins in the charger or not—on some you can't tell for sure.

Lugging HTs around can get to be a bore, as handy as they are to use. They get heavy after a while. The rigs I usually use weigh in at two pounds each. This isn't too bad in my parka pocket when I'm skiing, but it is a terrible load in a suit jacket breast pocket. The Genave weighs in at exactly one pound . . . half the weight of my Standard. It's about 3/4" shorter in length, which isn't a big deal. It is a half inch thinner, which is a big deal, and about the same width.

You probably already know as much about using HTs as I do. I find them incredibly useful. They are like several other gadgets . . . until you have them, you don't realize what you have been missing and they get used every day.

A pair of HTs is ultra handy to have in the car, so if you and your Tech-licensed XYL are going shopping, you can keep in touch without having to set up exact meeting times and

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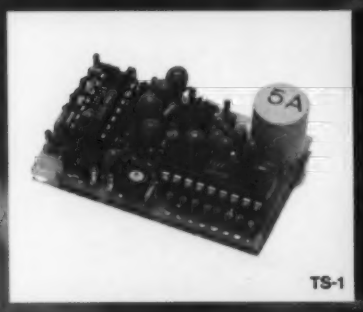

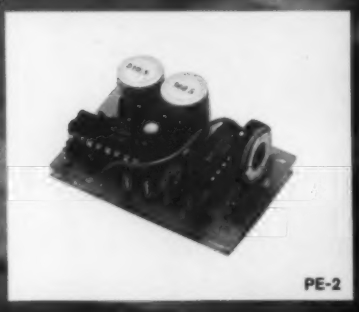

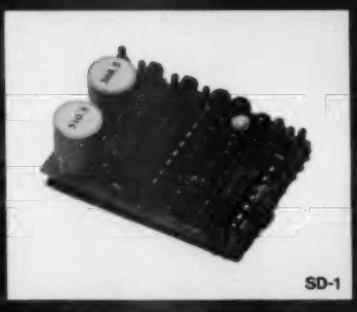

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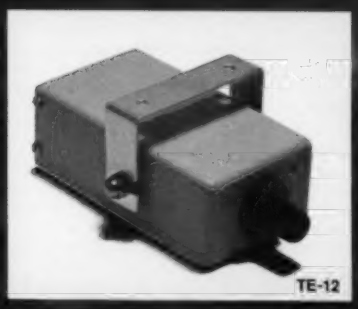
ME-3

TE-8


TE-12

ST-1

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TS-1JR Sub-Audible Encoder-Decoder • Microminiature version of the TS-1 measuring just 1.0" x 1.25" x .65", for hand-held units • **$79.95** complete with K-1 element.

ME-3 Sub-Audible Encoder • Microminiature in size, measures .45" x 1.1" x .6" • Instant start-up • **$29.95** complete with K-1 element.

TE-8 Eight-Tone Sub-Audible Encoder • Measures 2.6" x 2.0" x .7" • Frequency selection made by either a pull to ground or to supply • **$69.95** with 8 K-1 elements.

PE-2 Two-Tone Sequential Encoder for paging • Two call unit • Measures 1.25" x 2.0" x .65" • **$49.95** with 2 K-2 elements.

SD-1 Two-Tone Sequential Decoder • Frequency range is 268.5 - 2109.4 Hz • Measures 1.2" x 1.67" x .65" • Momentary output for horn relay, latched output for call light and receiver muting built-in • **$59.95** with 2 K-2 elements.

TE-12 Twelve-Tone Sub-Audible or Burst-Tone Encoder • Frequency range is 67.0 - 263.0 Hz sub-audible or 1650 - 4200 Hz burst-tone • Measures 4.25" x 2.5" x 1.5" • **$79.95** with 12 K-1 elements.

ST-1 Burst-Tone Encoder • Measures .95" x .5" x .5" plus K-1 measurements • Frequency range is 1650 - 4200 Hz • **$29.95** with K-1 element.

COMMUNICATIONS SPECIALISTS
426 W. Taft Ave., Orange, CA 92667
(714) 998-3021

places. You can consult on purchases. We often use them for talking with someone on the roof or a tower working on an antenna.

A group of us go skiing, each with an HT in the pocket. It makes it a whole lot more fun.

A few years ago, I used to have an HT on my belt at hamfests, but now that almost every ham has one, it is too difficult to find an unused channel, so I seldom even try. It sure used to be fun at Saroc a few years ago, keeping in touch with the FM gang, complete with the mysterious workings of the Gronk Network, which would let you talk all the way from Vegas to San Diego or out to Phoenix. Those were the years before Saroc got ruined by commercial exploitation.

Wayne Green W2NSD/1
Editor/Publisher

CSC's LP-2 logic probe.

PALOMAR ELECTRONICS DC-30 ANSWERS NEED FOR REGULATED 12-VOLT HIGH-CURRENT POWER SUPPLY

The Palomar DC-30 is a power supply for regulated 12-volt high-current requirements.

Its modular concept in a heat-sink chassis design delivers more efficient performance and longer life than old-style power supplies.

The Palomar DC-30 is designed and built to handle continuous loads up to 30 Amperes, with a momentary load capability 20% above the 30 Amp rating. Line voltage and load changes are fully compensated by the regulator. No overshoot on turn-on/turn-off or power failure.

The DC-30 is another example of the advanced technology from *Palomar Electronics, 665 Opper Street, Escondido, California 92025.*

CSC LP-2 LOGIC PROBE

Most economical of the three logic probes in Continental Specialties Corporation's *The Logical Force*™ is the versatile, inexpensive multi-family LP-2.

The LP-2 boasts a 300,000-Ohm input impedance, separate high and low LED logic state readouts, switch-selectable DTL/TTL or HTL/CMOS operation, and a pulse-stretching pulse-readout LED that responds with a blink to single pulses as fast as 300 nsec, and flashes at a 3 Hz rate to pulse trains up to 1.5 MHz.

Power is drawn from the circuit under investigation. Probe tips and power connectors are interchangeable with optional accessory configurations.

The Continental Specialties Corporation LP-2 logic probe is available at leading electronics dealers and distributors worldwide or direct from factory. For further information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven, Connecticut 06509; (203)-624-3103; TWX (710)-465-1227.*

Palomar's DC-30 power supply.

HELIWHIP DIPOLES FOR FIXED STATION OPERATION

Since joining the ranks of apartment dwellers a few years ago, as well as doing an increasing amount of operation from hotels and other temporary locations in Europe, I have experimented with many antennas of all sorts in an effort to find something capable of producing a useful signal while being small and easy to install and, at the same time, keeping TVI and RFI to a minimum.

After working my way through countless endfed wires, dipoles, and verticals with consistently disappointing results, I discovered the Anixter-Mark model HWD Heliwhip dipoles for fixed station operation. The Heliwhip antennas combine reasonable performance with a high degree of portability and ease of installation, providing an excellent answer to HF operation where space is restricted or it is not possible to put up a full-sized antenna.

The Heliwhip's end load concept reduces the overall length of the antenna to a manageable size which can be fixed mounted or rotated manually or with even the smallest TV rotator. The antenna is a true dipole so it is not necessary to provide a ground plane for it to work against. Construction of the dipoles is rugged, weatherproofed, and they will handle a full kilowatt.

The end loaded concept allows the length of the antenna to be reduced with only a slight loss in efficiency compared to a full-sized dipole. The dipoles are helically wound sections so proportioned as to result in a current distribution on the shortened dipoles which is essentially uniform and which produces a 50-Ohm match at the resonant frequency. When mounted in the clear, the antennas show very low reflected power.

Either vertical or horizontal polarization can be used, the important consideration being to avoid the closeness of metal objects which detune the dipoles. In restricted installation such as attics or near the ground, the Heliwhip dipoles show less coupling and detuning effects than do full-sized dipoles or ground-plane-type antennas.

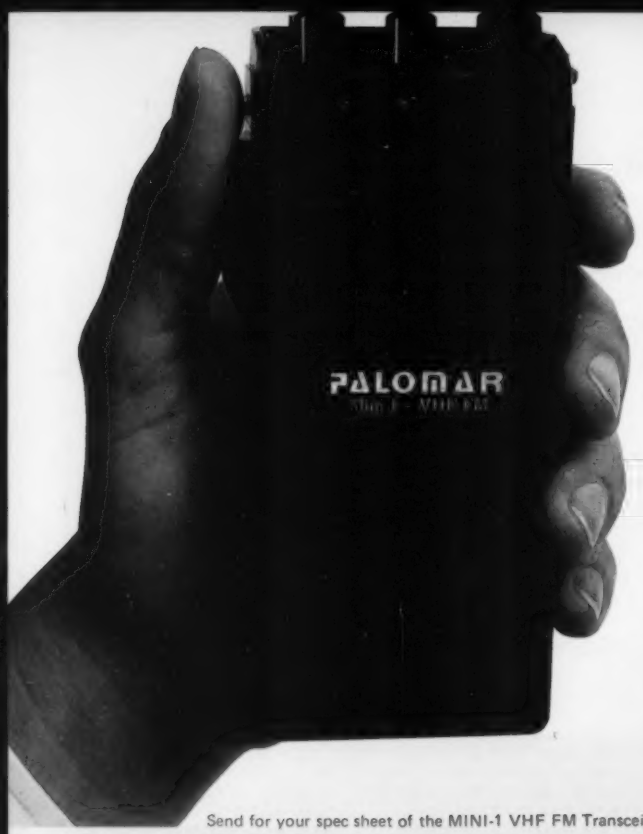
The HWD dipoles come with a clamp which allows clamping to a 1-inch mast. For optimum match, the mast should be insulated, such as a wood pole. An SO-239 connector is mounted on the dipole's center block for easy connection to the coax feedline.

For horizontal polarization, a typical installation would use a 1-inch mast to raise the dipole clear of the tower or other supporting structure and any other nearby antennas or other objects which could have a detuning effect. If it is not possible to mount the antenna in the clear and, instead, it must be placed in an attic or an apartment room, the detuning effects can be tuned out.

One end of the dipole is permanently attached to the center mounting block. This is the "hot" side of the antenna and the tuning is done on this element. The tuning sleeve can consist of a 7-inch piece of aluminum tubing slipped over the dipole. Any conducting metal can be used in place of the aluminum. Also, a piece of aluminum foil can be used and wrapped around the dipole element. The sleeve should be slipped over the end loading coil to the point where the edge of the sleeve just covers the start of the loading coil and most of the sleeve is resting on the covered fiberglass rod.

Table 1. Note 1: Since the operating bandwidth of the HWD-40 is not sufficient to cover the entire 40 meter band, a tuning sleeve is provided to allow the selection of the desired portion of the band.

Model	Length	Center Frequency	Bandwidth for 2:1 swr
HWD-10	8 ft.	29 MHz	1000 kHz
HWD-15	12 ft.	21.250 MHz	500 kHz
HWD-20	12 ft.	14.150 MHz	300 kHz
HWD-40	16 ft.	7.050 MHz	100 kHz (note 1)



WE'LL KEEP YOUR COMMUNICATIONS NEEDS FROM GETTING OUT OF HAND.

Introducing the PALOMAR MINI-1 VHF FM TRANSCEIVER . . . the Amateur Hand-Held set that's small enough to fit in your palm.

You're never out of touch with thousands of repeaters, so you're never out of touch with home . . . associates . . . friends. The PALOMAR MINI-1 operates normally in the Amateur 144-148 VHF region and with the AUTO-PATCH OPTION, you can access the telephone repeater and communicate through the telephone system.

The PALOMAR MINI-1 VHF FM TRANSCEIVER is only 152 mm high by 67 mm wide. Transmitter minimum output is one watt of power, with a total of 18 channels available, utilizing up-down split, down-up split or simplex, all with only 6 crystals.

The PALOMAR MINI-1 VHF FM TRANSCEIVER . . . it has all your communications needs well in hand.

Worth every dollar.
(And about the same size!)

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The parameters of the Palomar PTR 130k are the outer perimeters of logic technology.

Never before has any transceiver approached the capabilities of the Palomar PTR 130k!

It's the first completely multi functional transceiver ever made available to the public!

The Palomar PTR 130k is a miniaturized mobile transceiver capable of operating in 100 cycle resolution from 100 KHz to 30 MHz in all modes of transmission and reception. Instant frequency selection is available with the touch of a finger.

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PALOMAR ELECTRONICS
TECHNOLOGY AT THE SPEED OF SOUND

The new Nye Viking "Master Key," representing the first major improvement in telegraph key design in 50 years.

Connect an swr meter in the line and, using low power, tune the transmitter to the desired center frequency of operation. While carefully observing the reflected power, slowly slide the sleeve from its present position to cover more of the loading coil. Somewhere in this adjustment, a minimum swr will be reached. The swr will depend upon the degree of detuning from nearby objects in the field. Better than 1.5 to 1 should be possible in any condition with careful adjustment.

The above procedure will permit easy adjustment to any frequency in the band. With the sleeve removed, the frequency will be as shown in the table. As the sleeve is moved towards the end of the dipole, the inductance is decreased and the resonant frequency is increased.

Hellwhip dipoles really work. Using the 15 meter model temporarily mounted about 25 feet above ground and using approximately 10 Watts during a period of rather spotty conditions, WAC was easily made and more than 30 countries worked in the course of a couple of weeks of casual operation. The 10, 20, and 40 meter models have displayed a comparable level of performance.

For further information on the HWD Hellwhip dipoles, write *Anixter-Mark, 5439 West Fargo Avenue, Skokie IL 60076.*

Morgan W. Godwin W4WFL
Peterborough NH

Heath's new bidirectional wattmeter.

NEW BIDIRECTIONAL WATTMETER FROM HEATH

Heath Company, the world's largest manufacturer of electronic kits, has released a new wideband bidirectional wattmeter.

The IM-4190 (SM-4190 assembled version) is a self-contained unit that measures transmitted radio power up to 300 Watts and reflected power up to 30 Watts. Covering the 100 MHz to 1 GHz spectrum, the IM-4190, according to Heath, is an ideal tool for two-way radio service and repair or for the amateur radio enthusiast. The IM-4190 is capable of withstanding full power overloads on its lower scales without damage to the meter movement. A single 9-volt battery powers the IM-4190 so it may be used portably. N-type coax connectors are utilized for minimal high-frequency insertion loss. Adaptors for use with rf-type connectors are included.

The IM-4190 kit retails for $114.95 and the SM-4190 assembled version $195.00 (mail order Benton Harbor). For more information on the IM/SM-4190, write *Heath Company, Dept. 350-630, Benton Harbor, Michigan 49022.*

NYE VIKING MASTER KEY

The William M. Nye Company announces another new addition to their Nye Viking line of products with the introduction of the "Master Key"—the first major design change in telegraph keys in over 50 years. It is designed for the expert and perfect for the beginner!

Prime feature of the Master Key is a contact assembly isolated to keep the keying circuit separated from the base, the key arm assembly, and all exterior metallic parts. Thus, shock hazard is greatly reduced. With its heavy die-cast body and non-skid feet, the key does not need to be secured to the operating desk, nor does it require a sub-base. As with all Nye Viking keys, the contacts are gold-plated silver for sharp, sure sending. The base of the Master Key has a black wrinkle finish with nickel-plated exterior hardware. The adjustable action key arm is fitted with a Navy knob. The Master Key comes complete with 3 feet of two-conductor cord with attached 1/4" plug at a list price of $19.50.

This new product joins the famous-for-quality Nye Viking line that includes: Speed-X and Super Squeeze Keys, iambic keyers, low-pass filters, antenna impedance matching networks, and phone patches. All are manufactured by *Wm. M. Nye Company, Inc., 1614-130th Avenue N.E., Bellevue, WA 98005*, and are available at dealers throughout the U.S.A.

CHEMTRONICS ANNOUNCES THE SD5 MODULAR SOLDER/DESOLDER SYSTEM

Chemtronics, Inc., a leading manufacturer of solder and aerosol chemicals for industry, recently announced its new SD5 modular solder/desolder system. Designed to place both solder and desoldering wick right at the user's fingertips,

The Chemtronics SD5 solder/desolder system.

Telescoping Teflon* probe for precision application in high-density circuits
Snap D5 out of solder spool and pocket it for maximum convenience
Modular construction—D5 tool is removable; 2½" probe snaps into wick refill
With D5, you can shape or web the wick for greater absorbency
CHEMTRONICS SD5
SOLDER
ROSIN CORE
DESOLDER
The "System".
*Teflon is a registered DuPont Trademark

EXPERIENCE. There's no substitute for it. And TEN-TEC has it. More experience in solid-state HF technology than any other amateur radio manufacturer. Because TEN-TEC produced the *first* all solid-state HF transceiver for amateur radio. So, it stands to reason that the latest generations (the 540/544 models) benefit the most from that experience — in features, reliability, and operating ease. They are the "voices of experience."

TAKE MECHANICAL DESIGN. Experience tells us: make it rugged. So, like all fine solid-state devices such as computers and good test equipment, the 540/544 transceivers have their strength built into the chassis — the case is merely a cover. Ruggedness is carried over into the circuit boards as well. Component leads are "clinched," not just inserted, to give additional strength and to prevent annoying intermittents.

TAKE PHYSICAL APPEARANCE. Experience tells us: keep it simple. WWII is over, so is its technology, so why should your transceiver look like war surplus? The 540/544 transceivers look like tomorrow — small because technology makes it possible — few controls for the same reason. And they're elegantly handsome with black cases and brushed aluminum front panels.

TAKE ELECTRICAL DESIGN. Experience tells us: push the state-of-the-art. Example: we pioneered high power solid-state design for HF amateur radio gear. The advantages are numerous: efficient, small size, no lethal voltages, less heat, longer life, greater reliability. Example: broadband design. The advantages: easier operation for everyone, rag-chewers, DX chasers, even net operators. No out of reasonance danger, no need for a dummy load to prevent tune-up QRM, no boring, time-consuming "tune-up" procedures. Another example: computer aid. In circuit design, in manufacturing, for speed and optimization. Example: computer compensating oscillator drift to achieve rock-like stability.

TAKE SERVICING. Experience tells us: make it easy, for everyone. So the 540/544 transceivers have modular design with plug-in circuit boards. And trouble-shooting (if it's ever needed) can be done by you with ordinary test equipment. (Of course, Ten-Tec service people are ready to help).

TAKE OPERATING CONVENIENCE. Experience tells us: everyone wants it. Examples: high sensitivity with low internal noise makes the 540/544 transceivers great for DX, especially during poor band conditions. Full break-in on CW turns conventional QSOs into interesting conversations. Pre-selectable ALC gives automatic level control at various input powers (40-200 watts) plus optimized input power for linear amplifiers. "Semi-hard" keying effectively penetrates pileups, QRM, and QRN, yet is highly articulate and pleasant to copy. Pulsed calibrators are easy to identify. VOX that eliminates "anti-VOX" by triggering on a tone present in your voice but not in the transceiver speaker. (There are even more conveniences in the following "features" list.)

FEATURES — • Instant Band Change (no xmtr. tune-up) • Covers 3.5 to 30 MHz (plus One-Sixty with option) • 200 Watts Input — *all* bands • Receiver Sensitivity 0.3 uV • VFO changes less than 15 Hz per F° after 30 min. warm-up • 8-pole Crystal IF Filter • Direct Readouts — choose LED digital model or 1 kHz dial model • Optional 150 Hz CW filter • Optional Noise Blanker • Offset Tuning • WWV at 10 & 15 MHz • Separate Receive Capability • Automatic Sideband Selection, Reversible • Sidetone Level and Pitch control • Pre-Setable ALC • 100% Duty Cycle • S Meter and SWR Bridge • LED indicators for ALC and OFFSET • Modular Plug-In Circuit Boards • Broad Accessory Line

544 Digital — $869 540 Non-Digital — $699

Give your voice the Ten-Tec "Voice of Experience" treatment. See the 540/544 transceivers at your Ten-Tec dealer or write for full details.

arma

TEN-TEC, INC.
SEVIERVILLE, TENNESSEE 37862
EXPORT: 5715 LINCOLN AVE., CHICAGO, ILL. 60646

THE VOICE OF EXPERIENCE

SD5 consists of a pound spool of the company's hermetically-sealed MIL-spec solder with the unique D5 desolder wick dispenser tool snapped into the core of the spool.

SD5 is a simple, practical solution to the problems of service people, technicians, and production-line workers who must often alternate between soldering and desoldering. Since the unit is completely refillable, it will generate consistent traffic in refill sales.

The ingenious design of the removable D5 desoldering tool allows it to retract or snap in or out of the solder spool for the convenience of the user. This feature is also especially beneficial to the distributor whose customers are already stocking Chemtronics solder, as the D5 tool is compatible with all pound and half-pound spools. The tool has a 2½" heat-resistant Teflon™ probe, permitting pinpoint wick application, even in densely-packed circuitry. This makes it marketable to those users involved in miniature devices who could never use desoldering wick before. The probe also facilitates "webbing" or shaping of the wick for greater solder absorption, another popular selling point.

All components of the SD5 system are available packaged for sale separately, as well as complete SD5 units. Solder is provided in 16, 18, and 21 gauge in the following alloys: 63/37 (eutectic), 60/40, 50/50, and 40/60. Wick, which is manufactured of the finest materials to exacting specifications, is available in two gauges, .06" and .10", to cover all desoldering requirements. Its pure copper color enables users to see the absorption of solder, so they never overheat boards and components by working with a used portion of braid. In addition, it is treated with a vacuum-applied, pure, non-activated flux for high efficiency without corrosive residue. Wick refills snap into the D5 tool as easily as the D5 tool snaps into the solder spool core, making the entire SD5 unit simple and economical to refill. Both Chemtronics solder and Chemtronics desoldering wick meet all applicable federal and MIL-specs.

Like all Chemtronics products, SD5 is sold exclusively through distributors, with no competition from direct factory sales. Details are available from Chemtronics representatives or directly from *Chemtronics, Inc., Solder Products Division, 45 Hoffman Avenue, Hauppauge, N.Y. 11787; (516)-582-3322; (212)-895-1930.*

RADIO SHACK VARIABLE DC SUPPLY

With the growing volume of equipment and accessory items requiring low-voltage, low-current power sources, one of the handiest things an amateur can have around the shack is a variable voltage power supply. Radio Shack's Micronta variable dc power supply is just the ticket for such applications. Whether it's a low power transceiver or transmitter, receiver, keyer, speech processor, a piece of test equipment, or anything else requiring a well-regulated power source within the range of 0-24 volts and up to 1 Amp, the Radio Shack supply will handle it.

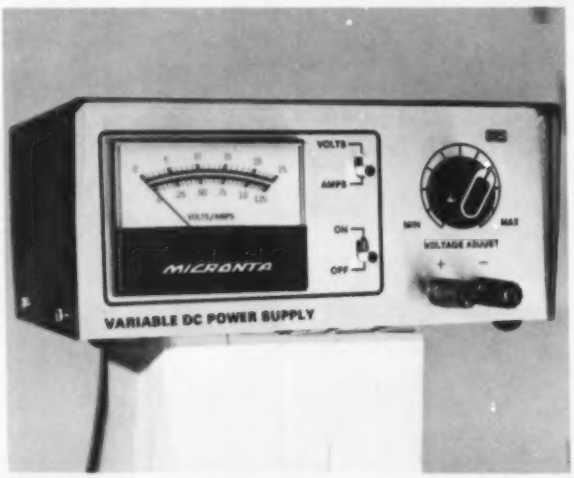
The unit features a large, easy-to-read meter to let you monitor the output voltage or current, and a precision IC voltage regulator and silicon transistor assure maximum dependability and long life. Operating from a 120 V ac, 60 Hz power source, the supply provides an output voltage continuously variable from 0-24 V dc at up to 1 Amp, with automatic current limiting. Load regulation is less than 480 mV (±2%) change at the output terminals from 0 to 1 Amp at 24 V dc. Line regulation is less than 150 mV change at the output terminals at 24 V dc at 1 Amp with line variation from 105 to 135 V ac. Ripple is less than 25 mV at 24 V dc at 1 Amp.

The power supply is electrically protected so that any load over 1 Amp will cause the current to limit at approximately 1 Amp maximum, eliminating the need for any external fuses or circuit breakers to replace or reset. The unit has adequate internal heat sinking so that it will run continuously—even with a short circuit across its output terminals. However, care must be taken not to block any of the ventilation holes by laying something on top of the cabinet. If the voltage drops when a load is connected, it is an indication that the power supply has gone into "constant current limiting."

Both terminals of the power supply are floating with respect to ground, so you can electrically stack power supplies such as for a positive and negative supply. If two supplies are to be connected in parallel, a 1 Amp diode should be placed in series with the output of each supply to prevent the current from flowing back into the supply. The unit's three-way binding posts take wires, banana plugs, or dual banana plugs with 0.75 inch centers.

Attractively packaged in a 3-7/8" x 8-3/16" x 6-1/2" cabinet, the Radio Shack Micronta variable dc supply (catalog number 22-123) sells for $39.95 and is available at Radio Shack stores.

Morgan W. Godwin W4WFL
Peterborough NH



Radio Shack's Micronta variable dc power supply.

SCANBE PATENTS DIP SOCKET MODULE

A recently developed DIP socket module has been issued U.S. Patent No. 4,072,380, announced Bob Miller, president and general manager of Scanbe Division of Zero Corporation.

The unique DIP socket module, developed by Engineering Manager E. G. Freehauf, incorporates both a power and ground pin within the socket housing and is available through local Scanbe distributors.

Modules are also available with a built-in recessed cavity with exposed contacts for purposes of mounting a decoupling capacitor. Use of the socket module in medium production quantities is said to result in savings of up to 25 percent per position. The patented design concept not only saves on circuit-board real estate, but also eliminates need for separate decoupling capacitors and the cost of installing separate wrap posts for power and ground connections.

Two 16-pin models are currently available. The discrete socket model not only offers the advantage of the integral power and ground connections, but it also offers greater reliability and performance of the sort associated with the company's ME-2 series solderless wrap sockets. The socket module also offers all advantages of the ME-2 series socket, plus the added benefit of the integral decoupling capacitor. It may be purchased without capacitor if desired.

The Scanbe Division of Zero Corporation manufactures a complete line of standard and custom electronic packaging products, including circuit card files, socket panels, socket cards, and dual-inline sockets. *Scanbe Division of Zero Corporation, 3445 Fletcher Avenue, El Monte CA 91731; (213)-579-2300.*

HEATH HD-1984 MICROPHONE/AUTOPATCH ENCODER KIT

The Heath Company has improved upon its original Micoder kit. The new version features a touchtone™ encoder with a crystal standard and single chip circuit. The microphone has a response from 300 to 3000 Hz that is tailored for clean voice transmission. Assembly took only an hour and a half and no special equipment was needed for alignment. The only adjustments needed are to set the deviation of your transceiver to match the microphone's output and then to adjust the single pot on the PC board for the same deviation when using the touchtone pad.

The unit comes complete with a six-foot coiled microphone cable and hanger clip. Power is obtained from a standard 9-volt battery (not supplied); Heath claims battery life to be approximately six months with normal use. The HD-1984 should be very popular with mobile operators since it is so quick and convenient to use—you can hold the microphone at the steering wheel and work the encoder while keeping an eye on the road.

The HD-1984 measures 3-3/4" x 2-5/8" x 1-3/4" and weighs in at just 9 ounces (including battery). The kit price is $39.95. *Heath Company, Benton Harbor MI 49022.*

Morgan W. Godwin W4WFL
Peterborough NH

The evolution of the MLA

When the MLA-2500 was first introduced it was a new concept in high performance amplifiers. Low and sleek yet powerful enough for the military. Some wondered . . . needlessly.

A promise kept.

The MLA-2500 promised 2000 watts PEP input on SSB. A heavy duty power supply. Two Eimac 8875's. And as thousands of Amateurs across the world have proven, the MLA-2500 delivers!

Now DenTron is pleased to bring you **The new MLA-2500 B.** Inherently the same as the original MLA-2500, the B model includes all of the above specifications plus a few refinements. New high-low power switching for consistent efficiency at both the 1KW and 2KW power levels, and 160 - 15 meters.

Tested and proven.

What better test for an amplifier than the Clipperton DXpedition? Even after 32,000 QSO's, and an accidental dunk in the ocean, the same 3 MLA-2500's are still amplifying other rare DXpeditions around the world — listen for them.

Convinced? Isn't it time you owned the amplifier that powered Clipperton and thousands upon thousands of radio stations throughout the world?

MLA-2500 B **$899.50.**

DenTron® Radio Co., Inc.

2100 Enterprise Parkway
Twinsburg, Ohio 44087
(216)425-3173

Enjoy All Five Bands

—with this novice no-trap antenna

Karl T. Thurber W8FX/4
233 Newcastle Lane
Montgomery AL 36117

If there is a fundamental rule about getting the most from your radio equipment, regardless of the size of your pocketbook, it is this: *Don't skimp on your antenna.*

This antenna tuner, or matching network, is representative of current designs, incorporating a built-in wattmeter which allows accurate and continuous power measurement and swr indication. Rated at 200 Watts rf power-handling capability, this tuner enables feedline swrs of 5:1 to be matched to the transmitter, being designed primarily for coax-to-coax matching. Other wider-range tuners enable loading of balanced-line (twinlead) or single-wire antennas to the low-impedance coax output of modern transmitters and transceivers. An antenna coupler should always be used in conjunction with multiband antennas for good harmonic suppression. (Photo courtesy of R. L. Drake Co.)

For top-notch DX work, a well-designed and properly installed skyhook is nearly as important as the transmitter or transceiver itself. You simply can't get maximum efficiency and radiated power output using a poor antenna system. Particularly with the relatively low power limitation of 250 Watts placed on the Novice, a good antenna is the best hope for the newcomer to work his fair share of DX.

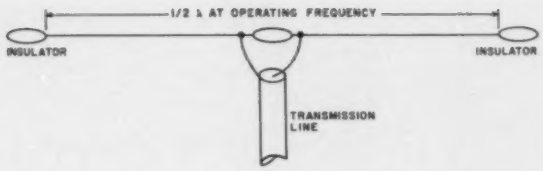
Many hams (and not just beginners) run into problems in erecting just one antenna, so the thought of constructing antennas for each of the five HF bands seems ridiculous, not to mention the effect on your neighbors. But, with about 66 feet of antenna space, you can erect a single five-band (80/75, 40, 20, 15, and 10 meter) antenna — one that uses a separate dipole for each band and which uses no traps.

First, before describing this antenna in detail, let's take a look at some common single and multiband antennas that are often suggested for the Novice and beginner, noting the advantages and disadvantages of each.

Old Faithful: The Half-Wave Dipole

You can cut a separate antenna for each band you want to work, although a 40 meter dipole will also work fairly well on 15 meters (due to an "odd half-wave harmonic" relationship existing between the 7 and 21 MHz dipoles). This is the only case where a dipole cut for one band will also work on another. Normally, trying to use a half-wave dipole on another band results in mismatches, high swr, increased possibility of BCI and TVI, and other problems, the least of which is poor efficiency.

The half-wave dipole shown in Fig. 1 is normally run in a straight line and centerfed with 75-Ohm coaxial cable or even 75-Ohm twinlead (though the latter appears to be going out of favor because it radiates and is harder to handle). The total length of the antenna is calculated by dividing the desired center



Unquestionably the world's most popular and most commonly used antenna, it is probably next to the single-wire in simplicity. However, its use is normally limited to the band for which it is designed. An exception to this is that an antenna resonant in the 40 meter band will also operate with a low swr (standing wave ratio) on 15 meters, three times the basic operating frequency.

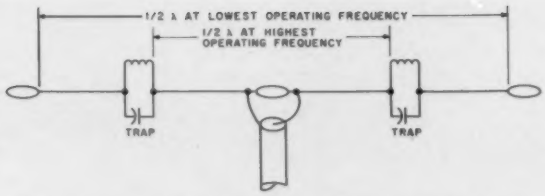
The half-wave dipole offers a good match to 75-Ohm coaxial cable or transmitting type twinlead. At the fundamental design frequency, the swr should be under 2:1 over a range of plus or minus 2 percent of resonance.

The dipole is basically a balanced antenna, both sides being symmetrical in nature. For this reason, a balun (or "balanced-to-unbalanced") transformer coil is often used to feed the dipole with coax, which is inherently an unbalanced cable (center conductor plus grounded outer shield).

The five-band antenna described in this article is a variation of the basic half-wave dipole. Other versions of the dipole are possible, such as the folded dipole, designed to directly match 300-Ohm feedlines. Again, the folded dipole is also a single-band affair.

Multiband operation is also possible using so-called "tuned feeders" (open-wire or twinlead transmission lines), coupling the transmitter to the antenna through a wide-range coupler or matching network. The flattop is usually cut to the lowest operating frequency to be used and transmission line lengths selected to give the least problems with the high line swr and antenna currents flowing on the line.

Fig. 1. Basic half-wavelength dipole antenna.



The trap antenna operates on two or more bands with practically the same efficiency as if a separate antenna was constructed for each band. In the two-band trap antenna shown, each parallel-resonant trap consists of a capacitor and coil placed at the ends of the shorter dipole section. The traps completely isolate the rest of the antenna (including other traps for other bands) from this section, thereby acting as insulators for rf energy at their design frequency. At lower frequencies, however, they will pass rf with little effect.

The same principle follows on up to the lowest frequency band on which the multiband trap antenna is designed to operate. The lowest frequency band doesn't require a set of traps, of course — it's simply the entire length of flattop end to end. A 160 through 6 meter trap antenna, for example, would require six traps on each side, for a total of twelve, to allow 7-band operation.

Note that, when traps are installed, there is some shortening of the antenna, due to the inductive loading effect of each trap. For example, the typical half-wavelength 75 meter dipole section would only have to be about 100 feet long because of the effects of the traps. The exact degree of shortening depends on the ratio of inductance to capacity in the traps; the more the capacity in the traps relative to the inductance, the closer the antenna will be to standard formula length.

Like the basic dipole, the trap is a balanced-type antenna and may be fed by coax through a balun transformer.

Fig. 2. Simple trap antenna configuration.

operation frequency in megahertz (MHz) into 468. Therefore, a dipole for the Novice segment of 40 meters (7.10 to 7.15 MHz) would be about 65' 8" long. But an 80 meter CW dipole cut for the low end of the band would be all of 133' 8", a length not all suburban lots can easily accommodate, even using the so-called inverted vee configuration where the center insulator is mounted at a fairly high point and the ends of the antenna are brought down close to the ground.

In practice, the center impedance of the half-wave antenna varies slightly with the antenna's height above the ground, wire diameter, proximity to other objects such as trees and buildings, etc. But it is safe to assume a close impedance match to 70- or 75-Ohm coax or twinlead; you can use 50-Ohm coax with only a slight swr increase. Furthermore, most recent transmitters and transceivers are specifically designed to work into 50- to 75-Ohm transmission lines, so tuning or matching is usually no problem with this kind of one-band, one-antenna setup. (You might be interested to know that RG-11/U and RG-8/U coax have about a 6% loss per 100 feet on 75 meters, while the smaller RG-59/U and RG-58/U cables have a loss of about 11%. Foam-type coax has less loss, while 73-Ohm balanced twinlead has about an 8% loss. Those losses tend to increase at higher frequencies and with impedance mismatches.)

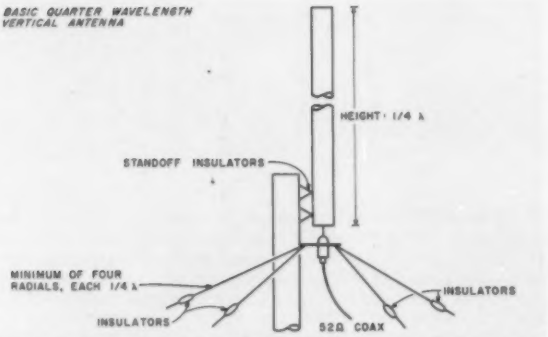
Although the basic half-wave dipole, being very straightforward in design and not relying on any gimmicks, gives the least trouble of any antenna, a separate antenna must be constructed for each band (except 15 meters). And that's not usually possible in most urban and suburban locations.

A Fair Compromise: The Trap Dipole

The "trap" antenna is a good choice for the operator who has the space for one full-sized dipole and wants multiband operating capability. It is similar to a regular wire dipole but has tuned traps that electrically isolate part of the antenna length. In a simple two-band example, if the antenna length from trap to trap in Fig. 2 is cut for 20 meters, then, from end to end, the same antenna can cover the 75 meter band as well, if its full length is a half wavelength on that band.

Two traps are needed for each band, one on each side of the feedline connection, except for the lowest band. They are parallel-tuned circuits enclosed in a waterproof casing, designed to resonate at the center frequency of the band. At their resonant frequency, they represent a high impedance to rf (thereby effectively acting as insulators), so the portion of the antenna beyond the traps will be out of the circuit, electrically speaking. As the traps are difficult to construct and properly adjust (not to mention making them waterproof), they're best purchased commercially. They are not terribly expensive. About a dozen manufacturers make amateur band traps. Most can be obtained complete with precut flattop, though just the traps alone are available for anyone who prefers to construct his own antenna.

The main advantage of the trap dipole over other multiband antennas is that a single antenna length will do for several bands. However, as is the case with all multiband antennas, the trap introduces a problem in harmonic radiation. If, for example, a transmitter is operating in the 80 meter Novice band, the second harmonic of the



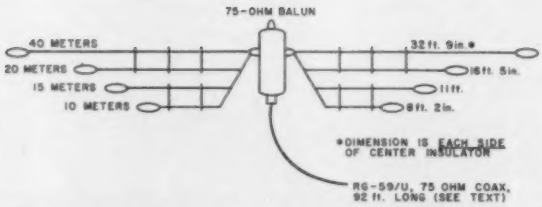
The quarter-wavelength antenna shown above is frequently used on the HF bands to put out a signal with a low radiation angle, especially good for DX work. It's also a good choice when there is insufficient room to support full half-wave flattops at the desired operating frequency.

A vertical antenna may be fed as a so-called "ground plane" as shown above, with at least four wires, each a quarter wavelength, extending radially from the base. The radials form an "artificial" metallic ground, allowing good low-angle radiation regardless of height above the ground. The vertical can also be fed directly against ground, eliminating the above-ground radials, as long as the antenna has a good low-resistance ground connection in the form of at least a half-dozen buried radials and several ground rods installed at the base.

At HF frequencies, the physical lengths required usually limit the vertical height to a maximum of a quarter wavelength at the operating frequency, whereas the smaller dimensions at VHF frequencies allow lengthening the antenna for some gain; 5/8-wavelength and even 3 half-wavelength in-phase configurations are common, giving several dB of effective gain over the basic quarter-wavelength antenna.

The vertical, like the dipole, is essentially a single-band affair, although traps may be inserted at appropriate points for multiband use.

Fig. 3. Vertical ground-plane antenna.



The antenna system pictured above is an adaptation of the basic dipole antenna; a group of centerfed dipoles are connected in parallel where the transmission line joins them.

On 40, 20, 15, and 10 meters, the antennas act as ordinary dipoles. There is fairly little interaction between the separate flattops. On 75 and 80 meters, the antenna is fed through the shorted ends of the coax (see text) as a single-wire-type antenna.

As the antenna, like the basic dipole, is essentially a balanced system, a balanced feedline would normally be used, such as 75-Ohm transmitting-type twinlead. However, direct coax feed will present little in the way of problems, or the balun transformer can be used as shown in the illustration to prevent possible imbalances in the system introduced by using the unbalanced coaxial cable.

As described in the text, the antenna itself is constructed of 450-Ohm open-wire TV transmission line, although other variations are suggested, such as the use of 300-Ohm twinlead or "ladder line."

Note that, in the configuration shown above, the 20 and 10 meter dipoles are the cutaway lower halves of the 40 and 15 meter dipoles, respectively. Each set of dipoles should be separately supported on the ends to minimize strain on the open wire line.

The physical design is flexible and may be varied to suit individual operating needs and available space, as suggested in the article.

Fig. 5 shows how the coax is jumpered at the transmitter end for 75 and 80 meter operation, while Fig. 6 shows details of the center insulator mechanical support connections.

Fig. 4. Short five-band no-trap antenna.

signal will also be radiated very nicely by the antenna — but it will be out of the top end of the 40 meter band, representing illegal operation and inviting a so-called "pink ticket" from the FCC.

Usually, you can stay out of trouble with multiband antennas by always feeding the antenna through an antenna coupler, which can offer an added 20 to 30 dB or more of harmonic suppression.

The problem of increased harmonic radiation and TVI applies also to the five-band antenna which will be described later on. It, too, should be fed through an antenna coupler, although most transmitter pi-network output circuits have fairly good second and third harmonic rejection characteristics if not "loaded" too heavily in an effort to get out that last Watt of rf. (If you suspect excessive harmonic radiation, check with a friend a few miles away, having him tune to your second or third harmonic — it should be received very weakly, if at all. It's a fairly good test for harmonic radiation, provided he's at least a few miles away.)

Using a multiband antenna may also aggravate TVI problems. So be sure to use a low-pass TVI filter installed in the coax between the transmitter and the antenna tuner and use the minimum grid drive necessary for full power output.

DXer's Choice: The Ground Plane

The ground-plane vertical is an excellent choice when horizontal space is a problem and if you're mainly interested in working DX. This type of antenna has a very low radiation angle, can be either ground- or mast-mounted, and can be directly fed with coaxial cable. It is shown in Fig. 3.

The quarter-wave vertical radiator must be insulated from ground for coax feed, presenting a feedpoint impedance of around 25 to 40 Ohms. This allows a reasonable match to 52-Ohm coax without using matching stubs or other devices in the transmission line. The antenna can also be fed with 70- or 75-Ohm coaxial line using a quarter-wavelength section of 50-Ohm coax between the line and antenna.

The vertical can be fed "against ground" rather than using the ground-plane radials running above ground (a little inconvenient on 80 and 40 meters because of their length). In this case, care is taken to get a good ground "mirror" by using several six- to eight-foot ground rods and using at least a half-dozen buried radials of various lengths to obtain the ground-plane effect and a low rf ground resistance.

While it's a particularly good DX antenna, the vertical sometimes doesn't work as well at the medium distances typically worked on 75 and 40 meters. Also, installing the radial system often presents a problem. Then, too, the ground-plane vertical is normally a one-band affair that also has a nasty tendency to aggravate TVI and RFI problems because of its vertical polarization and consequent low angle of radiation, which tends to direct your signal down and into the neighbors' TV, stereo,

and other electronic equipment.

A hybrid-type antenna that is becoming increasingly popular is the trap vertical, which uses tuned traps much like those used in the trap dipole, but which are inserted into the vertical antenna elements at the proper isolation points to allow multiband operation.

The multiband trap vertical — some designs are as short as 30 feet or less for full 80-10 meter operation — is an excellent all-around antenna and a fine DX choice when worked against a good ground system, but it is a lot more expensive than the simple wire flattop. Also, due to the complicated mechanical problems introduced by the traps, it's usually not practical to build your own trap vertical from scratch, whereas single-band verticals and dipoles are "snaps" for ease of construction.

Another popular and inexpensive multiband vertical is base-loaded, the antenna usually being 20-35 feet long and in one continuous length. With this antenna, a tap on the base-loading coil is manually moved to different positions on the coil until a good coax match is obtained. While 80 through 10 meters can be worked using one antenna and coil combination, the tap must be changed manually, a distinct disadvantage in inclement weather. The coil must also be waterproofed and otherwise protected from the elements.

A Short Multiband Antenna Using No Traps

As shown in Fig. 4, this antenna is a complete, easy-to-build, coax-fed, five-band, separate-dipole system. As with the basic half-wave dipole antennas discussed earlier, the dipoles are individually cut to any desired frequency within a particular band using the familiar dipole equation L = 468/F, where L is in feet and F in MHz. For general all-around operation, each dipole should be resonant in the center of its band. (On 10 meters, however, the antenna is cut for 28.5 MHz to cover the CW segment and the lower end of the phone band starting at 28.5 MHz.)

With this setup, on the band you're working, the transmitter and coax feedline "see" a good 75-Ohm match; the other paralleled dipoles — having a high impedance on other than the band they're designed for — just aren't there, electrically speaking, so they don't much affect operation on the other bands.

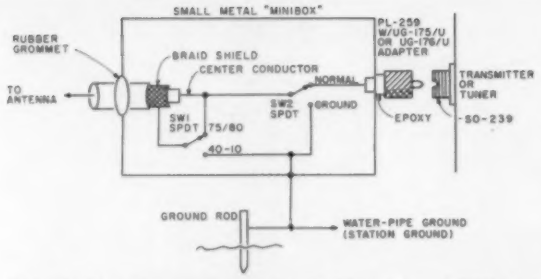
You'll find that, on 40, 20, and 15 meters, the antenna maintains a fairly consistent swr of less than 2:1. On the 10 meter band, the "bandwidth" of the antenna is roughly 500 kHz either side of the design center frequency (28.5 MHz) before the swr starts to become excessive. On ten, however, if a wide-range antenna tuner is used, the antenna may be made to load fairly well over the entire band.

Using paralleled dipoles with one common feedline is a very common practice, but the fact is that it still takes about 125' of flattop to radiate effectively on 80 meters. Even using commercially-designed trap dipoles, the length needed for 80 is usually at least 100 feet, with a very narrow operating frequency range due to the high "Q" of the traps. Again, this kind of space often is not available.

Here's how to get to 75 and 80 meters with this antenna: First, recall that the basic antenna length at 7.15 MHz is determined from the formula of 468/F, or 65' 6". Dividing this by two gives us the 32' 9" length on each side of the center insulator. Now, adding a length of coax of about 92 feet to the 32' 9" gives an effective antenna length of 124" 9", which represents a half wavelength resonant at the approximate center of the 75/80 meter band.

On 75 and 80, you should find that the swr is fairly low for about 150 to 200 kHz around the design frequency and shouldn't exceed 3:1 or so at these limits. But on this band — and this band only — the inner and outer conductors of the coaxial cable are connected together at the transmitter or antenna tuner end and fed like a single-wire antenna. (Note that a good ground connection for the transmitter or transceiver is important for good results when the antenna is, in effect, fed as a single wire against

One of the few antenna tuner kits on the market today, the 5-band Apollo Trans System tuner kit is a wide-range coupler based on the classic design by Lew McCoy which appeared several years ago in QST. The tuner will match low-impedance coax cable or open-wire lines. It will also handle random-wire antennas. The kit sells for about $125. Also shown here is a combination wattmeter and direct-reading standing wave ratio bridge, a useful device in tuning up and adjusting any antenna. The device behind the antenna coupler is the Apollo "Little Giant" beam antenna, a very unusually-configured mini-antenna designed for single-band operation on 40, 20, 15, or 10 meters. It measures just 27" high and 22" wide. A slightly larger version is designed for 80 meter operation. (Photo courtesy of Apollo Products, Box 245, Vaughnsville OH 45893.)



This device allows convenient switching from a 75/80 meter single-wire configuration to straight multiple-dipole operation.

SW1, in the upper position, shorts the coax shield to the inner conductor for 75 and and 80 meter operation, while, in the lower position, it is connected to ground in regular fashion. (Note that the coax is not grounded to the metal box where it enters but, rather, is routed through a rubber grommet.)

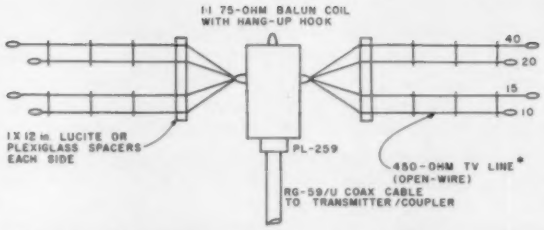
SW2, when in the normal position, connects the antenna system to the transmitter or antenna tuner for regular operation. In the ground position, the antenna is grounded for lightning protection. The antenna should always be grounded when not in use for maximum protection.

The PL-259 connector is mounted to the minibox by drilling a hole just large enough to accommodate a UG-175/U or UG-176/U reducer adapter, screwing the reducer onto the PL-259 through the cabinet wall. It can be epoxied into place if desired.

The two SPDT switches can be ordinary electrical switches for low-power work. However, heavy-duty ceramic rotary switches are suggested for more than 100 Watts or so power levels.

The jumper box should be connected to a good ground system. This is particularly important when working the antenna as a single-wire on the lowest band.

Fig. 5. 75/80 meter jumper box pictorial diagram.



A commercially-manufactured 1:1 balun is used as a convenient center insulator for the antenna; the hang-up hook may be used if you want to tilt the antenna for space into the inverted vee arrangement mentioned in the text.

The 450-Ohm open-wire line may be run directly to the balun, but a neater and stronger antenna results if you run the dipole sets to a 1" × 12" Lucite™ or Plexiglas™ bar, firmly anchoring the line ends to the bar. Short (6-8") wires may be run from the bar to the anchoring hooks on either side of the balun coil. Note that all wires on each side of the balun are connected to each other, resulting in each dipole being electrically paralleled with the others.

For maximum strength, each dipole set should be separately supported, minimizing strain on the antenna as a whole. Most baluns are equipped with a coax receptacle; therefore, the cable should be fitted with a PL-259 connector for easy connection to the antenna.

As discussed in the text, 300-Ohm heavy-duty twinlead may also be used to construct the antenna, as may polyethylene "ladder line." Solid copper wire may also be used to form the 40 meter antenna with the other dipoles being suspended from it. The ARRL Antenna Book *gives a number of mechanical techniques for multiple-diode center support and may be consulted for more information.*

If you prefer, the balun coil may be eliminated and replaced with a standard center insulator with little effect on performance.

*Fig. 6. Center insulator mechanical support connections for 5-band antenna. *Burstein-Applebee catalogue no. 2A9967-9.*

ground.)

The jumpering can be done manually using alligator clips, or you can construct a jumper box for the purpose, as shown in Fig. 5. The box also provides for grounding the antenna when not in use, for lightning protection, and for discharge of static buildup on the antenna.

Since the antenna operates with a fairly low swr, even on 75 and 80, the transmission line could be fed directly by the pi-network output circuit of the transmitter or transceiver without using an external antenna tuner or coupler. But, an antenna tuner or coupler should in fact be used to reduce the very real possibility of radiating out-of-band harmonics — something a multiband antenna will do very well, as mentioned previously. The tuner also does a nice job tuning out any reactance at the band edges, which is particularly useful on both 75/80 and 10 meters where swr may get a bit ragged at the band edges.

On the top four bands, the radiation pattern will closely resemble the familiar "broadside" half-wave dipole pattern, while on 75 and 80 meters, the pattern is essentially omnidirectional with elements of both vertical and horizontal polarization caused by the radiating coax which is now an integral part of the antenna. If your space is even more limited, you can mount the antenna in inverted vee fashion, which requires only a single high support and less horizontal space. By doing this, you very slightly reduce the antenna's resonant frequency, feedpoint impedance, and bandwidths, as the angle between the two parts of the dipole is decreased. As long as you don't make the angle at the apex smaller than about 90 degrees, you should have no problems using the vee, and the slightly lowered angle of radiation should be a plus for DX work.

This low-pass filter provides extremely high attenuation of signals higher than 43 MHz, effectively eliminating the possbility of radiating undesirable harmonics in the TV bands through the antenna. Multiband antennas tend to aggravate harmonic radiation problems, including TVI, but the use of a low-pass filter and antenna coupler in the transmission line will do a great deal to reduce the possibility of TVI problems. While the particular Drake filter shown is rated at only 100 Watts, other filters by Drake and a number of other manufacturers will handle all amateur power levels. (Photo courtesy of R. L. Drake Co.)

Build It

The five-band antenna is made of good-quality TV-

type 450-Ohm open-wire transmission line, heavy-duty 300-Ohm twinlead, or commercially-available polyethylene "ladder line" sold by many large mail-order electronic suppliers, such as Burstein-Applebee, Lafayette Radio, and others. In most situations, the open-wire line or twinlead is strong enough to support the antenna, if the lower dipoles are run separately to a support and if the coax is also supported at some point so the full weight of its entire length doesn't fall on the antenna flattop. (You can also use #12 or #14 copper wire for the main 40 meter flattop if you like—I'll discuss that variation later on.)

Each end of the 40 and 15 meter dipoles (the top halves of the open-wire) is connected to an insulator, with the centers being tied through a Lucite™ or Plexglas™ support bar to the main center insulator. The 15 meter dipole should be separately supported on the ends and run to a nearby tree or any available mast or pole. The 20 and 10 meter dipoles are simply the cutaway lower portions of the 40 and 15 meter open-wire line or twinlead. The center of each dipole is connected in parallel with the one above it at the center insulator. Fig. 6 is a close-up view showing how all this is done.

When hanging the antenna, you should place it as high as you possibly can above the ground (at least 25 to 30 feet) and far away from other objects that might detune it or block its radiation path. You can orient it for the direction you're mainly interested in covering, but it will still radiate fairly well in all directions. Maximum radiation will be in a "doughnut pattern" lying at right angles to the wire.*

Getting down to the nitty-gritty of actually constructing the antenna, your best bet is to use a commercial 1:1, 75-Ohm balun coil as the center insulator. While a balun isn't absolutely necessary, it's helpful in getting a symmetrical radiation pattern and keeping down antenna currents on the coax (except on 75 and 80, where the coax is part of the antenna itself). If you want to use a balun — and it is a good idea to do so — they are hard to build and waterproof yourself, so it's probably best to buy a commercial model, costing anywhere from $10 to $20. Unadilla Radiation, Green Insulator, Kaufman Industries, Barker and Williamson, Palomar Engineers, and a host of others make them. Their ads can be found each month in the various amateur publications.

They're all good products. Two added pluses for the baluns are that, first, they usually come equipped with a built-in SO-239-type coax connector for easy feedline attachment, and second, their internal construction usually places the antenna at dc ground potential, affording some degree of built-in lightning protection for the antenna. Just make sure that you use the one-to-one (1:1) kind of balun, not the 4:1 type, which is designed to transform a 300-Ohm folded dipole's impedance to match standard 75-Ohm coax.

Whether or not the inherently balanced dipole should always be fed through a balun is a moot technical point that is likely never to be decided with any finality. I have never found it absolutely necessary to use one, though you will find that many antenna purists insist that baluns are necessary to keep current from flowing on the outside of the coax transmission line. (Some operators prefer to use balanced 75-Ohm twinlead and mount the balun at the transmitter end — take your pick.)

While on the subject of baluns and dipole center connectors, some balun manufacturers also sell the connectors less the balun "innards." These connectors are very handy even if you don't want the balun feature, making it easier to build a professional-looking antenna with a good weatherproof feedpoint connection. They're well worth the cost — usually less than $9 or $10 — and are a lot less hassle than building your own center connectors. Of course, since they are weatherproof, they can be reclaimed and used again and again with future antennas.

To complete the installa-

This Palomar balun is designed to match unbalanced coaxial line to balanced dipole antennas over the range of 1.7 to 30 MHz. According to the manufacturer, dipoles fed directly with coax cable are susceptible to cable radiation which can lead to TVI, BCI, rf feedback in the station, and noise pickup when receiving. The balun (balanced-to-unbalanced transformer) converts from the essential unbalanced coax to a balanced output by transformer action. Note the "hang-up" hook" useful in supporting inverted-vee-type antennas. Baluns are made by numerous manufacturers, such as Unadilla Radiation, Kaufman Industries, Greene Insulator, and others. (Photo courtesy of Palomar Engineers)

*Note: A centerfed, horizontal half-wave dipole radiates in a fairly wide pattern broadside to its length and poorest off the ends of the wire. However, from a practical standpoint, it's really not that important in what direction you run a dipole, especially on 80 or 40 meters, although orienting its ends in a north-south direction is a pretty fair compromise for stateside contacts. On the 20, 15, and 10 meter bands, directivity is somewhat more pronounced, so, if DX is your forte, you might want to route it with this in mind. In any case, don't be overly concerned about its orientation.

1. Keep horizontal antennas as high as possible — at least 25 or 30 feet above the ground or buildings.
2. Bend the dipole into a vee if you like, but avoid bending the ends if at all possible. Don't be overly concerned with the antenna's orientation.
3. Feed horizontal flattops at the center rather than at the ends; balun matching coils are nice, but are not absolutely necessary.
4. Use high-quality coax feedline; its advantages far outweigh its disadvantages. Small-diameter coax is okay up to about 500 Watts.
5. Vertical antennas are good, provided they are worked against a good ground system. But they tend to be noisy on receiving and may aggravate TVI and BCI.
6. Protect your antenna against lightning and ground it whenever you're not using it. You may be very sorry if you don't!
7. Use an swr meter or R-X antenna bridge to check out and adjust your antenna, but don't get hung up on swr. It can't always work out to 1:1.
8. Install a good station ground using connections to cold-water pipes and/or ground rods driven into the earth. (This goes hand in hand with lightning protection.)
9. Use an antenna coupler or matching network in the coax line if for no other reason than getting added harmonic suppression. The ones with built-in swr bridges and rf power meters are very handy and allow continous monitoring.
10. Use a low-pass filter between the transmitter or transceiver and the antenna coupler — don't give harmonic-caused TVI a chance!
11. Multiband trap antennas are fine, but can be frustrating to adjust if you've never "pruned" an antenna before. Be prepared to do some tweaking to get consistent performance from band to band.
12. Beams, rhombics, and other advanced antennas will add punch to your signal, but cut your teeth on some basic types first.
13. If your antenna doesn't work properly, check for continuity and look for shorts in the line; also check the swr carefully. Double check all solder joints and make sure all connections are mechanically sound. Above all, don't try to force power into an antenna that doesn't want to load up — find out what the problem is before ruining a final output tube or messing up your final tank circuit.

Table 1. Antenna installation tips for the beginner. Summarized here are a baker's dozen rules of thumb that should help you in getting the maximum results from that HF skyhook. Take heed! While not everyone would agree with all the items of my "laundry list," they do represent some 20-plus years of observations in experimenting with a wide range of antennas, from short indoor single-wires to multi-element beams.

tion, you can connect the ends of the dipole to good-quality ceramic, glass, or porcelain insulators and support the ends with weatherproof rope, heavy-duty plastic clothesline, or wire (broken up with strain insulators at random intervals to prevent undesired resonances near the antenna which may affect its performance or swr). Also, don't pull the antenna too tight; leave just enough sag to keep it flexible in the wind. In very limited space, you can hang the center of the antenna on any available high support (preferably nonmetallic) and let the ends droop in inverted vee style. You can also run the center portion of the antenna horizontally between two closely-spaced supports, bending the ends and hanging them vertically. (I don't recommend the latter with this antenna unless absolutely necessary, as it will result in a reduction in efficiency and is a bit tricky if open-wire is used to make up the dipoles. But supporting the center is a good idea, especially if you use open-wire line for the main 40 meter section, which has to bear a good deal of weight.)

The coax transmission line is best kept away from trees, power lines, and buildings, particularly since, on 75 and 80 meters, it is being fed as a resonant or tuned line. It should be run outdoors as much as possible, at right angles to the dipoles, if possible, to minimize undue distortion of the radiation pattern by the coax. Use TV-type standoff insulators in routing the coax to the shack.

Incidentally, RG-59/U coax is suitable for up to 500 or 600 Watts input if the swr is low, while you should use RG-11/U if you're running more power than that. Be wary of using cheap CB-type coax, as the shielding tends to be poor. The cable also tends to become very lossy at the higher frequencies.

The dipoles will interact with one another to a very small extent. If you experience problems in keeping the swr fairly consistent from one band to another, you can try pruning the antenna slightly for each band using a grid-dip meter, R-X antenna bridge, or swr meter. You can also experiment by adding about 4 feet of 75-Ohm coax to the specified 92-foot length and then trimming off about 4" of coax at a time, until the swr becomes fairly consistent from band to band. The extra length of coax won't adversely affect 75 and 80 meter operation, but it will shift the resonant frequency somewhat lower than originally designed.

Do your initial antenna tune-up without the coupler or tuner being in the line, so that you'll be sure that you're measuring the antenna's characteristics, not the coupler's ability. After you have attained an acceptable swr on all bands, move the swr bridge to between the coupler and the transmitter for routine tune-up and band changing.

One point before leaving the subject of tuning: Tweak the antenna all you like, but, if it works well on all bands and shows a reasonable swr on your favorite band segments, leave it alone. Tuning any multiband antenna for a perfect 1:1 match on all bands is almost impossible and probably won't make much difference in overall performance anyway. Actually, from a practical standpoint, an swr of even 4 or 5 to 1 doesn't cause a great signal loss or necessarily cause loading problems at the transmitter. This would start to matter at 6 and 2 meters with a long feedline, but, as a rule, if the power is going into the line, the antenna has to get most of it. Spending a lot of time trying to get the swr down to exactly 1:1 at all points in the band just won't help your signal that much.

Don't Be Afraid To Experiment

The antenna should work well as designed, but by no means must it be constructed exactly as described. After all, a good deal of the fun in amateur radio is experimenting to determine what works best for your own purposes.

For example, you may want to use a nonbalun center insulator instead of the balun coil. Or, you may, for added strength, want to use #12 or #14 copperweld steel wire for the 40 meter section, using the open-wire line or twinlead for the 20 and 10 meter dipoles and skipping the 15 meter section entirely, since the 40 meter antenna will do a fairly good job on 15. Many variations are possible. Refer to the *Radio Amateur's Handbook,* the *ARRL Antenna Book,* or the book *73 Dipole and Long-Wire Antennas* for more ideas on multiband antenna configurations.

You may even elect to forget the 75/80 feature, if that band isn't important to you. In that case, the lowest band you have to

consider is 40 meters, so the length of the coax is unimportant, since it operates as an untuned line on all bands covered.

Then, too, each dipole's length can be set to favor a particular portion of the band. For instance, you might want to cut them for the CW portions of 40 and 20, but make them resonant in the middle of the 15 and 10 meter phone bands instead, depending on your interests and the operating privileges your class of license conveys.

Bear in mind that, if you want to carefully tune the antenna for a particular band segment, it's best to start with lengths several inches longer than calculated from the dipole formula to give yourself a little play when pruning the antenna. Also, if the 92 feet of coax specified seems a bit long, there's nothing magic in the length. It was chosen to make up a half wavelength on 75 and 80 when combined with each leg of the antenna for ease in loading. You can experiment with shorter lengths. With other lengths of coax, however, on 75 and 80 the antenna may behave more like a random wire, and a wide-range antenna coupler may have to be used to tune out the large amounts of reactance you can expect.

In any case, make all measurements carefully and be sure to solder all joints properly. A cold solder joint can wreak all kinds of havoc, with intermittent operation, TVI, and RFI very likely results.

This is a simple antenna, but one not involving too many performance-robbing compromises. And, you will very likely find that, in general, the simpler the antenna, the better the results and the fewer operating problems you're going to have.■

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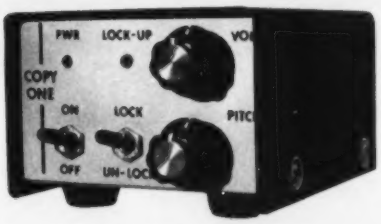

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Reincarnating Old Test Equipment

—a 1942 capacitance meter is born again

Photos by WA3PTC

My Cornell-Dubilier capacitance bridge had served long and well. Purchased in 1942, the model BN cost about $12.00. Eighteen years later, the 12A7 failed and was replaced. In 1972, a resistor failed, and then, in May, 1977, the "new" 12A7 failed. Obviously such an unreliable piece of gear was begging for replacement ... until the price of an equivalent unit revealed the true extent of inflation.

Examination of the problem called for recycling, something we hams had been doing for years before the idea caught on in the popular press. The only item needed to bring the unit back to life was a bridge balance amplifier and an indicator of balance. I had always been less than thrilled with the magic eye indicator, as it had to be shaded from ambient light to really see when balance was achieved.

In my case, I decided on a new housing, since the old one had been cracked while proving that gravity was still a viable force. The cabinet from an old five-inch Sony TV was mated to a panel made out of a formica cutoff from a woodworking project. Fig. 1 shows the original schematic.

Electrically (as shown in Fig. 2), all parts associated with the old bridge amplifier and magic eye indicator were discarded, keeping the basic bridge components intact. The voltage divider, consisting of a ten-megohm resistor and a one-megohm resistor (across the output of the bridge), serves two purposes – first, to keep the impedance high at this point to allow the bridge to function, and second, to control the amplitude of the input to the op amp used as a bridge amplifier.

The output of the bridge when unbalanced can run as high as thirty volts, and at balance, depending on the range in use, can be as low as a few tenths of a volt. The divider reduces this variation of amplitudes by a factor of eleven to avoid real problems with the op amp, which is set up for a gain of ten.

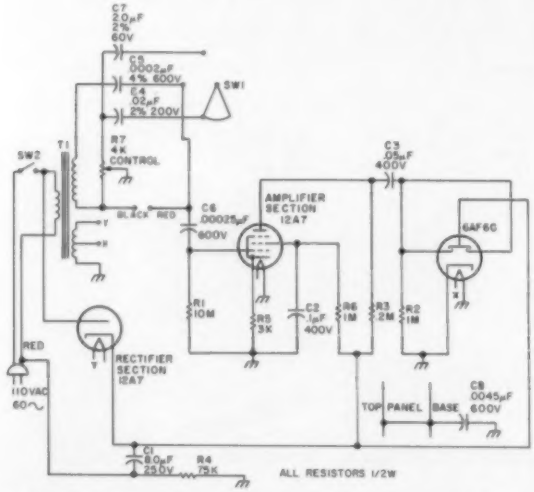


Fig. 1. Circuit diagram for capacitor bridge model BN.

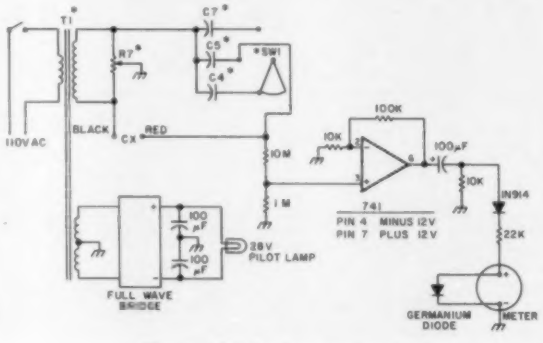


*Fig. 2. *Original components.*

The balance indicator is a meter salvaged from an old tape machine and serves quite nicely in this function with the advantage over the old magic eye in that it does not need to be shielded from ambient light. Since the meter you may use may vary in sensitivity from the orphan I wound up using, here is a simple way to set up the proper series resistor to scale the meter. Unbalance the bridge and insert just enough series resistance so that the meter pins full scale. Then shunt the meter with the germanium signal diode, as shown in Fig. 2, and the meter indication should drop about one or two scale divisions. This simple method obviates any fuss and feathers log amp problems to handle the signal variations that the op amp handles. It allows for a very nice null reading to show balance, while saving the meter from overload.

The original transformer has two windings — one driving the bridge and the other a center-tapped winding which formerly lit the filaments of the tubes. This latter winding is used to feed a full-wave bridge, producing the dc voltages needed for the 741 op amp. I put a 28-volt pilot lamp across the output of the supply, which serves the second purpose of acting as a bleeder.

Be sure to ground the dial plate of the bridge to the ground terminal of the supply. If you use a metal cabinet, keep the bridge circuitry isolated from it, as it may upset bridge calibration on the low capacity scale.

Many times, I have seen similar units at flea markets or hamfests selling for a five-dollar bill. They are well worth recycling in this manner, considering the current cost of an equivalent bridge. ■

LETTERS

from page 14

teur Radio Club of Durham NC.
Charles W. Bryan WA4VKX
Durham NC

We know that articles about the 10 GHz band are of growing interest to amateurs. That's why we publish them. It's up to individuals to decide how they will use this expanding technology.

We feel that it is our obligation and the obligation of every citizen to speak out against a law so obviously foolish and useless as the 55 mph speed limit. For a couple of years now, the National Highway Traffic Safety Administration has been touting the 55 mph limit as a lifesaving measure. In fact, a close look at the NHTSA's own statistics shows that the reduction in traffic fatalities since 1973 can be credited to such factors as safer automobile design and increased use of seatbelts . . . but not the 55 mph speed limit. Check the May issue of Car and Driver *for a discussion of this topic.*

Although the government has set standards for exposure to microwave radiation, there is considerable informed opinion that the standards are not nearly stringent enough. I, for one, object to being irradiated against my will by police radar until it's been proven beyond a doubt that such irradiation is harmless. Thus far, the jury is still out.—Jeff DeTray WB8BTH/1, Asst. Publisher.

MICROWAVES

I was glad to find the article on microwave safety by Bob Thornburg in the April, 1978, issue of *73*. However, I was concerned that the article mentioned only the thermal

Continued on page 43

Steve Zawacki WA1UUK
8 Lind Terrace
Randolph MA 02368

Finding Radio Pests

—*basics*

It's now Thursday afternoon and that donkey who has been kerchunking the repeater since Sunday night is still making a pest of himself. What's worse is that he's adding an occasional "word" to his kerchunks. If your patience is now as short as the repeater's squelch tail, then it may be time for a fool hunt.

The only difference between a fool hunt and a fox hunt is the beast you're chasing. I respect foxes!

Almost all hunters agree that the fun's in the chase, not in the capture or kill. Also, the police and the courts usually frown on any creature, even a jammer, being physically abused or having its den vandalized. I haven't met a junior jammer yet worth a kilobuck fine and two years in a cage.

So if, after considering all the legal ramifications of assault, your group still wants to find the nuisance, here's a reasonably inexpensive and fairly accurate method of radio direction-finding. It may not be the fastest way (no microprocessor support), but the techniques have proved reliable over many years of practical application.

Maps

First of all, no attempt at radio direction-finding (RDF) will be successful unless accurate maps of the repeater coverage area are available. The center spot on your RDF map should be the repeater site. The more detailed the map, the better. Road maps can be used, but they are usually off scale. This will affect the accuracy of the RDF attempt.

Fig. 1. RDF station overlay.

Equipment

Next you need stations with the minimum equipment necessary to conduct RDF. Since you can't rely on the entire net being available when you need it, try to designate as many stations as possible as RDFers. Each RDF station must have a receiver with a signal strength meter, a rotatable unidirectional antenna, and a means of precisely determining the direction of the antenna.

The receiver must be capable of receiving the repeater's input frequency. It does no good to try to RDF the pest on the repeater's output frequency, unless you want to make sure he hasn't run off with your repeater.

The antenna array does not have to be exotic. Any commercially-made beam will perform admirably. The most important thing is to be able to determine the exact direction the beam is pointed at any given time. The simplest system to use is the 360° circle with 0° as north. Some maps contain a grid, true and magnetic north. It doesn't matter which north your RDF net uses, just as long as everyone in the net uses the same one. Otherwise, the results of your RDF attempt will not be usable.

Antenna director calibration can be as simple or complex as you want to make it. The KISS (keep it simple, stupid) principle is usually the best to follow in situations where elaborate equipment is not available. Simply determine the exact direction of each RDF station from the repeater site using your designated north and the 360° circle. Now that you know this direction, the next step is to compute the direction of the repeater from the RDF station. This can be accomplished using the old pathfinder's trick of finding the back azimuth to a known location.

The formula for computing a back azimuth is: $X^\circ = Y^\circ + 180^\circ$ (if $Y^\circ < 180^\circ$) or $X^\circ = Y^\circ - 180^\circ$ (if $Y^\circ > 180^\circ$) ("X" being the desired back azimuth; "Y" being the bearing of the RDF station from the repeater site).

As an example, if station A is on a bearing of 70° from the repeater site, then the repeater site will be on a bearing of 250° from station A. If station B's bearing from the repeater is 310°, then the repeater's bearing from station B is 130°. So, whenever either station wants to calibrate its antenna director, the operator simply tunes in the repeater, adjusts the antenna direction until the strongest reading is indicated on the receiver's signal strength meter, and aligns the rotor director dial to read the predetermined back azimuth.

RDF Net Operations

The successful RDF activity can be divided into three parts: target notification, line bearing acquisition, and plotting.

1. Target notification.

The person designated as the controller of the RDF net should be the one to contact

the RDF stations with RDF requests. Since the repeater will probably be ineffective due to the jammer, and FM simplex may not reach everyone, the most logical means of communications may be Ma Bell's telephone system. If you really want to go through the efforts of RDF, then be prepared to spend a few bucks for phone calls.

2. Line bearing acquisition.

This is when the fun starts. After receiving an RDF request, the station performs a quick antenna director calibration on the repeater output frequency. Not only does this allow the RDF station a chance to insure the accuracy of his "shot," but it also lets him observe what the jammer is actually doing (kerchunking, swearing, etc.). The next step is to change to the repeater input frequency and try to hear the jammer. If the jammer's signal can be received, adjust the direction of your beam for maximum reading on the receiver's signal strength meter. The bearing indicated on the antenna director is then reported to the net controller.

Don't be surprised if a number of RDFers cannot receive the jammer. This is another good reason to have as many stations as possible involved in the RDF net.

3. Plotting.

Now we're getting down to the nitty-gritty. The net controller has now received the line bearings from the RDFers. He then goes to the RDF map which shows the locations of all the RDF stations on a plastic overlay (Fig. 1). Each RDF station location will have bench marks indicated above and below with 0° and 180°, respectively. These bench marks are necessary to orient a protractor on the map at each RDFer's location.

Let's follow the steps of a normal RDF plot. The controller has received a line bearing acquisition from RDF station A. He takes a protractor and orients it on the bench marks at A's map location. He makes a grease pencil mark on the protractor scale corresponding to the received bearing report. He then draws a straight line from A's location through the bearing mark and beyond. These steps are repeated for each RDF report.

At some spot on the map, a number of the bearing lines will intersect. It's a rare occurrence to have three or more lines intersect at the same spot. As a result, a process known as "triangulation" is employed.

Triangulation is the most commonly accepted method of determining a transmitter location based on RDF. However, it is only as precise as the accuracy and reliability of the equipment used by the RDFers.

Fig. 2 shows a situation in which three line bearings have been plotted on a map, forming a triangle. In order to determine the location of the jammer, place the point of a compass (the kind used for drawing circles) in the center of the triangle. Adjust the compass so the pencil part reaches the furthest angle of the triangle. Now make a circle with the compass. Your mystery station will be located somewhere within this circle (Fig. 3).

If the net controller receives more than three RDF reports, he uses the ones that form the smallest triangle.

While this system may not seem too precise, it's about as accurate as you'll find for the size of the investment. Remember, the system will be used by radio amateurs, not the Coast Guard or NASA. Very few hams have the loose capital to establish an elaborate locating station. The hobby forces us to use whatever we can afford to accomplish what we desire.

If a more precise location of the joker is desired, then out with the mobiles and DF loops. At least the triangulation method will narrow the search area dramatically.

The next problem comes with identification of the jammer. Now that you know who he is, what are you going to do about it? Any action outside the law will only lead you, not the jammer, to the clink. Take whatever advice that the FCC and any lawyer hams in your group are willing to give concerning any post-identification activity. Playing vigilante can be hazardous to your future. "If you can't do the time, don't do the crime." ■

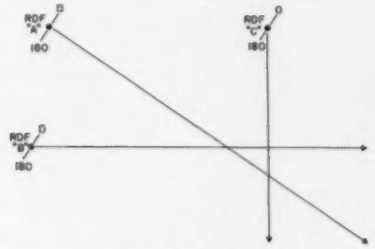


Fig. 2. RDF plot.

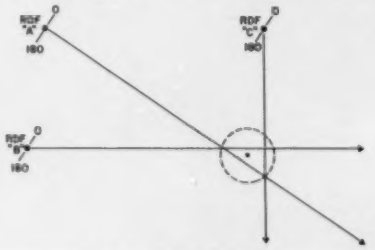
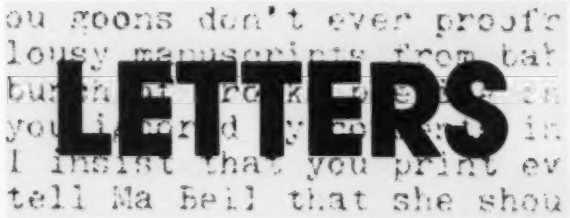


Fig. 3. Final RDF plot.



from page 41

dangers of microwaves. Although thermal, or heating effects, can be severe—such as the rapid cooking of skin and corneas— there are other, *nonthermal* effects which can, over time, produce their own serious results. These effects are called nonthermal because they do not occur by the *heating* of tissue, but instead by the interaction of certain radio frequencies with molecules or chemical reactions which occur in the body. We are already familiar with many nonthermal effects in our daily lives: radioactivity (radiation "burns," organ damage from ingestion, cancer), x-rays (cell damage, birth defects, cancer), and ultraviolet rays (sunburn, eye damage, skin cancer).

In the Dec. 13, 20, 1976, issues of the *New Yorker* magazine, author Paul Brodeur described in a long and scholarly article the frightening history of microwave research in the United States. He also described the long-term effects of microwave radiation (illnesses, eye problems, and more) which have plagued the lives of many who were at one time in their lives involved with microwaves. Although the U.S. armed forces were very slow, even resistant, to the idea of this type of nonthermal danger (indeed, the proper safety precautions would have made the cost of research considerably higher), the Russians very early showed an awareness of the possibility of such danger by setting their safety limits far below those of the U.S.

Even though the power levels involved in amateur radio are small, and the effects of these particular frequencies are not fully known, the experimenter should be aware that:

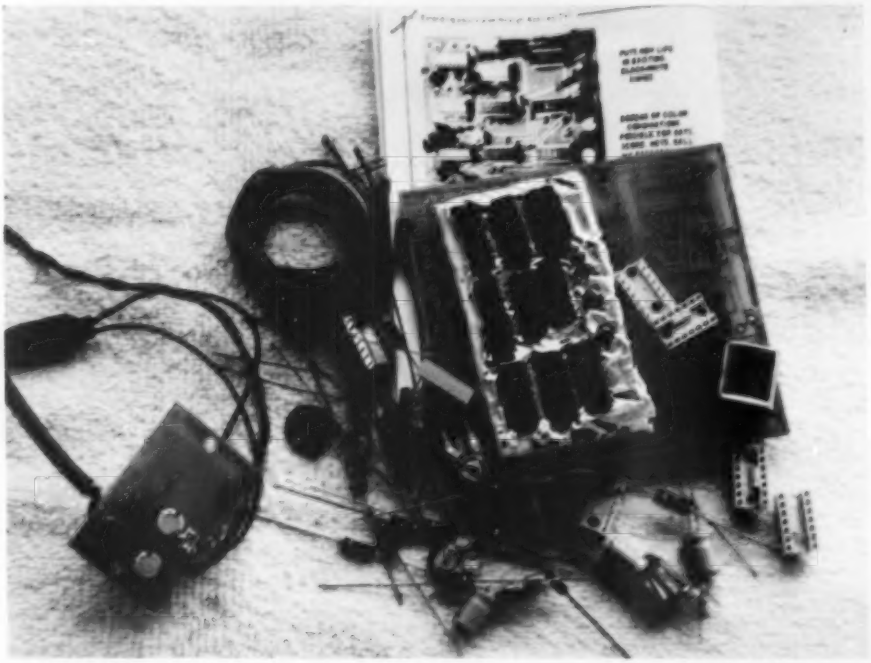
Continued on page 46

Dave Ingram K4TWJ
Eastwood Village #1201 So.
Rt. 11, Box 499
Birmingham AL 35210

Video Magic For Your Home

—to make boredom disappear

If you like working with unique aspects of modern electronics, there's an unlimited amount of enjoyment awaiting you in the world of home video equipment. Although this fascinating area of entertainment has previously been relatively expensive, today's market now offers low-priced closed circuit TV systems, cartridge video tape recorders, and a variety of TV games which can be assembled and used in your own home. A miniscule combination of these units can quickly turn your den or recreation room into a personalized "Aladdin's Castle" of fun. Technical expansions of these systems are limited only by one's imagination, desires, and available time.



Home brew haven! Here's the ATV Research Chroma-plex 7700 color converter for home video games ready for construction. Highly detailed instructions make this affair just a few hours long. The unit on the left is the ATV Research Pixe-Verter which permits video to modulate a simple VHF oscillator.

As the area of "non-radiating video systems" is quite diversified, this article will attempt to describe some of its capabilities and assets on an informative basis. Specific construction projects, like interface circuits, converters, etc., vary with individual setups, thus precise technical details have been kept to a minimum. I'm sure, however, the ideas presented here will give you an accurate overall view of home video fun.

TV Games

A quick glance through the advertisements in any recent issue of *73 Magazine* will verify that this field has expanded substantially since the days of TV ping-pong and hockey.

Modern game ICs generate auto races, airplane dog fights, duck shoots (a modified BB gun with a photo-transistor down its barrel does the "firing"), and much more. The games are easily assembled on foolproof printed circuit boards, and you're ready for action. The usual cost of these game chips

is between 10 and 20 dollars.

If you build a game that has video only output, you'll need to tap into your home TV at a point on the first video amplifier's input. Carefully check the schematic of your television before deciding on this point. Locate a place which is after the 4.5 MHz and 920 kHz traps and doesn't upset any biasing arrangements of the video amplifier's input. Problems with local TV stations "feeding through" video stages and mixing with game displays can be eliminated by using a switch to temporarily disconnect b-plus from rf and i-f stages.

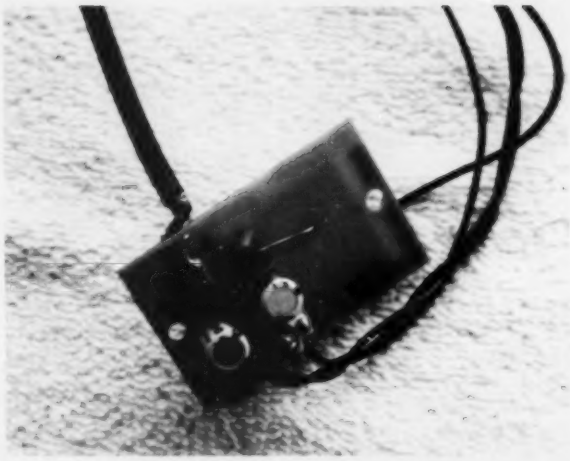
As an alternate solution to modifying the home TV, an externally modulated VHF oscillator (commonly known as an rf modulator) may be connected between a TV game's video output and the antenna terminals of any television for instant action. One example of such a converter is the Pixe-Verter which costs approximately 9 dollars and is manufactured by ATV Research, 13 and Broadway, Dakota City, Nebraska 68731.

If you tire of viewing any of your TV games in black and white, ATV Research also manufactures a Chroma-Plex 7700 digital color converter which performs beautifully. The unit connects between a game's video output and a VHF oscillator or TV's video amplifier and generates dozens of color combinations. The cost of this kit ranges from 20 to 35 dollars, depending on the size of your junk box.

CCTV Systems

There's a kaleidoscope of useful applications for the presently popular and comparatively inexpensive closed circuit TV systems. These units are available from sources like Advance Video, 5835 Herma, San Jose, California 95123. The systems can be used for video babysitting, for implementing hands-off magazine reading (close-up lenses permit 6x magnification), for monitoring outdoor activities, for amateur fast scan and slow scan TV operations, and much more (sunbathing enthusiasts will find their standard equipment zoom lens an absolute necessity!). Let your wit and humor be your guide.

Most CCTV cameras are basically inexpensive fast scan units which output with 4 MHz of conventional TV video. You'll need another one of the previously mentioned modulated VHF oscillators if you want to connect it to the antenna terminals of a regular TV set. That, incidentally, brings to mind a quick and easy means of getting CCTV signals from one end of your house to the other. Simply disconnect your outdoor antenna (you surely don't want the neighbors to confirm their vicious suspicions of you) and use your antenna leads to convey the signal between rooms. Be sure your TV signal doesn't radiate further than a hundred feet, however, or the FCC gang will hunt you with a 5-ton ax.



Close-up of ATV Research Pixe-Verter. This unit is a miniature TV transmitter which may be modulated with conventional video. Output is selectable – channels 2 through 6.

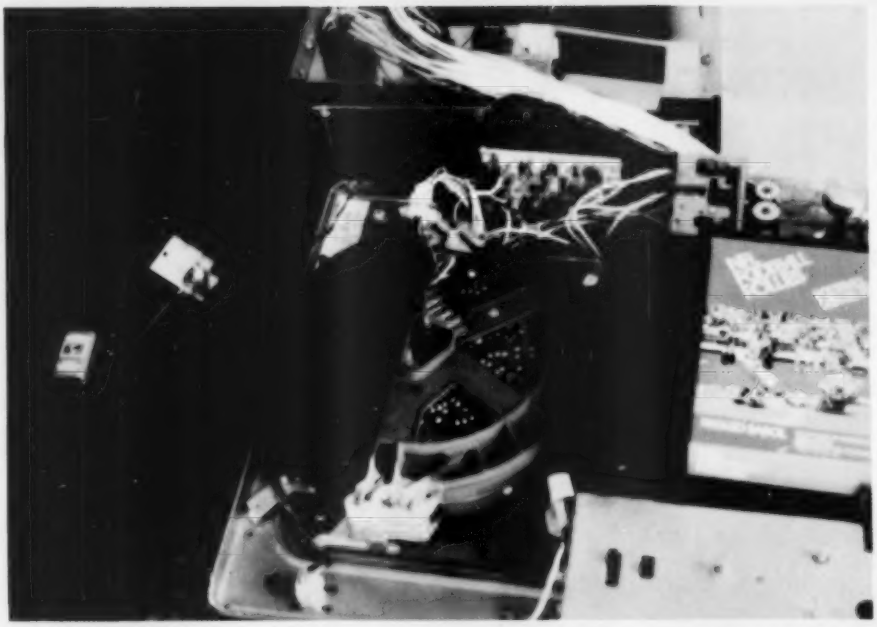
Video Tape Recorders

Until recent times, one could merely dream of owning his personal video taping system. The typical cost of such units was definitely in the kilobuck range, and specific information on their use was rare as slippers for snakes' feet. Today, however, that situation has changed radically. Companies like Advance Video now distribute high quality color video cassette recorder/players which sell for approximately 300 dollars and perform very well. Advance Video's matching CCTV

Video entertainment gear set up and ready for action. The cartridge tape deck is propped on the footstool and support circuitry is behind it. The CCTV camera and TV game can drive either television or tape recorder. The recorder can also tape programs during the operator's absence.

camera sells for 150 dollars. These units can be preset to view household functions or record TV programs during your absence and replay them as desired. A fantastic variety of prerecorded programs for these units is also available from Advance Video. The time required to set up one of these cassette video tape recorders is a brief evening's activity. You'll need another modulated-VHF oscillator if you want the VTR's output to feed the antenna terminals of your TV set. However, you must connect the VTR's input to the video detector output in your TV for recording off-the-air programs (remember the previously described bias considerations before diving into your TV's circuitry). Advance Video Company distributes an inexpensive interface board and detailed instructions for correctly making these connections, so there's very little chance of going wrong if you follow their instructions.

Once the tape system is working smoothly, you can have a ball taping programs, viewing special interest tapes, watching the family, and practically anything else your imagination can devise (let's see . . . football replays are on channel 3, the next door neighbor's on 4, the Friday movie's on 6, the TV game's on 8 – there's still room for more activity on channels 9 and 11).



Close-up of Advanced Video's cartridge tape system during use. Deck assembly contains rotating pickup heads, tape transport, and main controls. The electronics unit is the separate "fish tank" behind the deck. The small unit on the footstool is the VHF oscillator which interfaces video outputs to the television's antenna terminals.

Tying Everything Together

Once you've acquired a small arsenal of video equipment and get it scattered around the living area, you'll need a means of housing everything in one place. A large home brew cabinet with controls on the top and input/output connections on the rear should fill the bill perfectly. If you plan this construction project with an eye toward future expansions, a complete video entertainment center will be the final result. You can then sit back and play games while recording the best shots (plus adding a variety of colors for special effects), produce instant replays of televised shows, tape record your own home movies, and much more without stopping every few minutes to rewire patch cables. Later you might interface your pet computer to the TV for video readouts or modify a tape cartridge module to act as an analog storage device for generating unusual TV games. Ideas like "SSTV Slalom Game" (May, 1977, *73 Magazine*, page 58) can also be implemented on fast scan TV, if you care to experiment with new methods.

In conclusion, I would like to emphasize that nonradiating video systems are tremendous fun, relatively inexpensive, and require only minor technical expertise to construct and operate. They can be enjoyed for an indefinite length of time and depreciate only slightly in value. They are also a perfect means of getting started in two other fascinating fields: amateur fast scan television and slow scan TV. Now, wouldn't you rather be operating video, too? ■

LETTERS

from page 43

1. nonthermal radiation damage occurs over a long period of time and is not felt immediately;

2. the exact safety limits and the mechanisms of damage are not known, although long-term evidence from numerous sources shows that danger does exist; and

3. should long-term effects be proven for amateurs working with microwave equipment, this may be used as firepower to further curtail the frequencies available for amateur radio enthusiasts.

I think anyone working with microwave radiation would do well to take as many precautions as possible to minimize exposure, even beyond the thermal safety limits suggested by Mr. Thornburg.

Further information may be obtained in the book *Microwaves: The Deadly Radiance*, based on the original articles.

Bob Silberstein
Cambridge MA

DE-ZAP STRAP ZAP

I am writing you regarding the unexpected safety hazard in the design of the "De-Zap Strap" article in the May issue. If the strap is made as shown in the article, the wearer will be hard (low resistance) grounded anytime the strap touches the case of a grounded piece of equipment, metal bench, etc. At this point, the stage is set for a serious, possibly fatal, accident. All that is needed now is to accidentally touch a voltage source with the other hand. The ideal electrocution path now exists across the chest cavity and less than .1 Amp current flow will be fatal.

Continued on page 53

FREQ OUT. FOR LESS.

100 Hz to 50 MHz.
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Novice Guide To Phased Antennas

—part II

Many hams have been intrigued by the idea of phasing three cardioid patterns, as shown in Fig. 1. It seems as though that would make a good beam which could be electronically rotated. The idea is usually seen with antennas spaced a quarter wave apart and with a quarter-wave delay to make possible firing in six directions for complete 180° rotation.

I have talked to quite a few hams who have tried this, and, while it is impressive to hear the signal go down and up as the pattern is rotated, there are some problems.

For one thing, the pattern for quarter-wave spacing and quarter-wave, or 90°, delay is 120° between half-power points, as you can see in Fig. 2. This means that you can get pretty complete coverage—better than a single antenna in any direction—with just two antennas.

Another problem is that the third antenna, whichever one is unused, causes distortion of the pattern unless it is completely detuned. This means, usually, that both the main coax lead and the shield must be disconnected. In addition, if the lead-in is near an odd multiple of a quarter wave at the frequency in use, the disconnected lead may still show an electrical short, and the antenna will still cause trouble. This problem does not occur with two antennas, since both are driven.

It is, however, easy and profitable to phase three antennas with half-wave spacing, as shown in Fig. 3. All can be driven broadside, causing three figure-eight patterns, covering six directions, with very good nulls in the unwanted directions. All three leads are identical, and there is no necessity to add or subtract delay lines. The swr is low with no matching problems. By making all the lines multiples of a half wave, the disconnected antenna effectively opens the unused antenna, detuning it completely. At a half wave apart, there is little effect on the other two antennas.

A figure-eight pattern is useful for stations in the center of the U.S.A. so that stations in the east and the west can be joined in a rag chew. You can easily apply the pattern to your location and see if it would be good for you.

The inverted-vee dipole can easily be phased, either end fire as in Fig. 4, or collinear as in Fig. 5. The collinear array takes a long space, but not much width. It could, for example, be installed on a fence line, without taking up any appreciable yard space. Fed to a T-connector between the two antennas, it would give a figure-8 pattern with about 3.8 dB gain. It would not be practical to switch a delay line in, as the ends of an inverted vee have a loss of about 6 dB.

The end-fire array can be spaced a quarter wave and arranged with a delay line of 90°, or a quarter-wave delay line. If two feedlines are brought into the shack, the delay line can be switched into either line, thus reversing the array. The pattern will be the cardioid similar to Fig. 2.

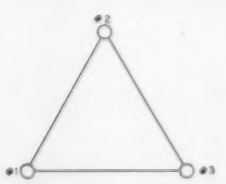

Fig. 1.

Fig. 2.

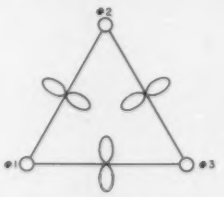

Fig. 3.

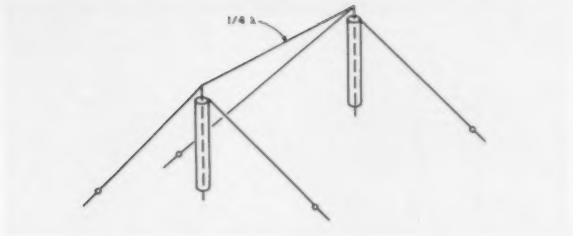

Fig. 4.

Any of the delays and patterns shown for vertical antennas in part I of this article can be used with these antennas. Both the collinear and end-fire arrays can be suspended either from two push-up masts or a nylon cord strung between two towers or poles.

By using eighth-wave spacing, and a 3/8-wavelength (135°) delay, it is possible to support a pair of inverted vee dipoles from a single tower using a piece of masting as a spreader, as shown in Fig. 6. On 40 meters, this would be 17', and the delay line would be 33'10". The gain would be close to that of a 2-element beam.

Of course, the ultimate array is the one shown in Fig. 7 with two end-fire pairs in broadside, which combines the figure-eight pattern of the broadside connection with the end-fire unidirectional pattern to obtain a narrower and higher gain unidirectional lobe.

In the May, 1975, *Ham Radio*, this array was written up in detail, after I designed the array for use in Antarctica at McMurdo Station. Combining the 3.8 dB gain of the broadside array with the 4.5 dB of the end-fire array gave nearly a 9 dB gain, as shown in the pattern at C. This is better than most 3-element beams, and the angle is lower than a beam unless it is installed at least a half wave above ground.

This array was made up of verticals, but the same plan could be used with inverted-vee dipoles. Using the pair shown in Fig. 5 and placing a similar pair a quarter wavelength behind them with four push-up masts, you would have a potent arrangement. You could feed the broadside pair with a T-connector, and bring the two feedlines into the shack. By inserting a quarter-wave piece of coax in either line, you could reverse the array as needed.

This would take a little space—about 140 feet long and 34 feet wide—but the four masts and the wire would cost less than a beam, and you would not have any concrete to pour or towers to climb. It would be less subject to man-made electrical interference than verticals, and, by using a pulley at the top of each mast, you could make tuning adjustments or change antenna lengths easily.

The principles of phasing can also be used for two meter antennas and CB antennas to advantage. I once had a pair of CLR CB antennas mounted on a piece of 1¼" water pipe with ells at each end and a T in the center. The whole thing mounted on a TV antenna rotator. The pipe was 9 feet long for quarter-wave spacing at 27 MHz, and it really made an excellent beam. See Fig. 8.

That was where I found that the two antennas used must be identical. I used an older CLR vertical and added a new one. In the meantime, Hy-Gain had

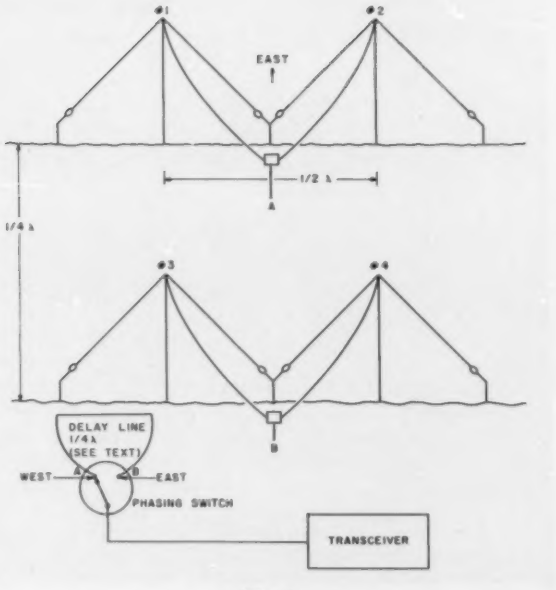

Fig. 5.

added an rf coil in the base, and the pattern was not at all what I wanted. I phoned them, and they explained the change, after asking me if I had used an old one and a new one. I got a second new one, and then it worked perfectly.

The coil in the base threw the phase out 180°, and that made a cardioid pattern impossible.

Picture a pair of two meter verticals spaced 9½" (quarter wave) or 19" (half wave). If a repeater needs to fire from an outlying area into a city or to give coverage along a highway, this is the easy way to do it. A CB station in a service area can make a figure-eight pattern to aim up and down a highway and cut down interference from stations in town by using half-wave spacing.

You have probably seen the pairs of CB verticals on cars, with one on each side of a car and the antennas fed by equal lines to each antenna. This gives a slightly elongated pattern in the direction of the highway and cuts down the signal from the sides.

There are several popular antennas which use the phasing principle, such as the ZL special, the 8JK, the Sterba curtain, and the Bruce and the bobtail curtain, among others. Even the quad can be driven as a phased array.

There is one basic difference between a parasitic array and a driven array. The antennas in a parasitic array are either shorter, for a director, or longer, for a reflector. The antennas in a driven phased array are of identical size. This makes it possible to use antennas which it would be difficult or impossible to lengthen or shorten, such as trap-

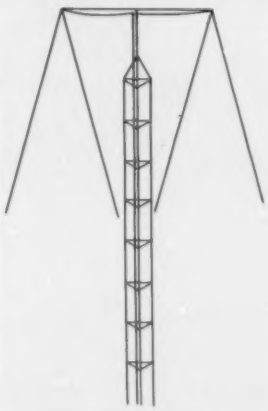

Fig. 6.

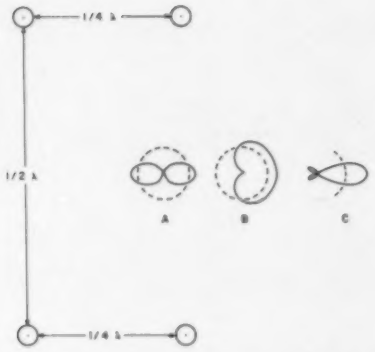

Fig. 7. Horizontal radiation pattern of half-wavelength spaced antennas is shown at A. The pattern at B is that of quarter-wavelength spaced antennas. At C is the pattern of the four-element phased array.

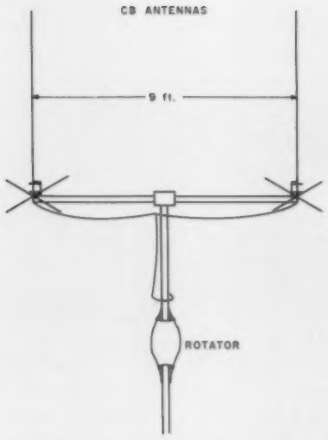

Fig. 8.

type antennas. It also makes possible instant reversal of direction without a rotator or complicated switching.

One example is a pair of Mor-Gain antennas which I used with excellent results as a phased pair. A Mor-Gain antenna is a shortened design which reduces the length by nearly half and allows the use of two or more bands with the same antenna. See Fig. 9.

The ones I used are shown here. Each consisted of a 40/20 arrangement, with the 40 meter section being reduced from 66 feet to about 37 feet, and had interlaced a full length 20 meter antenna. I used them very successfully in Antarctic phone patch traffic as a pair of slopers on forty meters, with half-wave spacing. I often used to pin the meter on the KWM2A at South Pole Station with this antenna.

A friend of mine, K7PPQ in Las Cruces, New Mexico, is preparing to use the same two antennas as a pair of phased verticals suspended from a 17′ boom. The shortness of the antennas makes it possible to use a 40′ mast. To suspend a full-size 40 meter vertical dipole would take a 70′ mast. The lead-in from each antenna will be brought into the shack, so delay lines can be inserted for either reversal or to change the pattern to a broadside figure-eight when desired.

Rodney O'Rourke K5VYJ used a pair of Mor-Gain antennas as a two-element 40/20 beam with excellent results by spacing them 17′ with a quarter-wavelength delay on 40 meters, which was a half-wavelength on 20 meters.

At this point, I had better explain a few things about delay lines in phased arrays, as well as some matching methods. I won't make it very difficult, as this applies to all phased arrays, unless you use a tuner to take care of the matching.

When a pair of antennas are spaced a quarter wavelength and a coaxial delay line is used to feed the leading antenna, the coax line will not reach between the two antennas. This is because the .66 velocity factor makes a quarter wave of coax too short. For example, if two antennas on forty meters are spaced 34′, which is the free-space distance, the coax, with a velocity factor of .66, will be only 22′6″.

There are two solutions. One is to use a ¾-wavelength delay line, which will be 67′6″, and will reverse the direction. The other is to bring the two lines into the shack, or at least away from the antennas, and then insert the delay line.

I usually bring the lines into the shack, where I have complete control over the phasing. As long as the two lines are equal, they can be any length.

The next thing is the matching. While a 50-Ohm line is a pretty good match for a single vertical, when two are connected in parallel, the impedance falls to 25 Ohms. To counteract this, we often use a quarter wavelength of 72-Ohm line to raise the 50 Ohms to 100 Ohms in each line so that, when they are paralleled, they would be 50 Ohms again.

When you use four

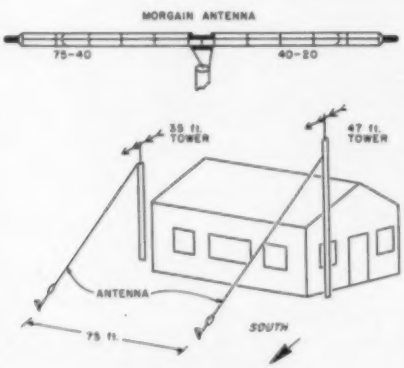

Fig. 9.

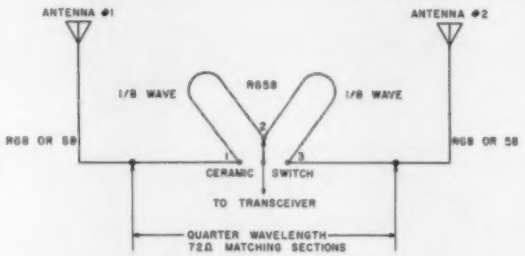

Fig. 10.

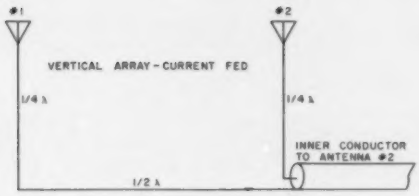

Fig. 11.

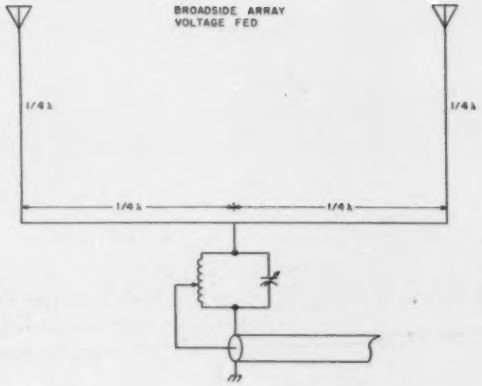

Fig. 12.

antennas, you can go through the same procedure. You can put a 72-Ohm section in each line from the pair of antennas. Of course, if you have a good matchbox, you won't need to use this method.

Switching is another problem. Fig. 10 shows a simple method of moving a delay line from one direction to the other and also of feeding the pair in phase for broadside operation.

When the switch is on position 1, the quarter-wavelength delay is in series with antenna #2, and the reverse is true on position 3. On position 2, the signals are fed into both antennas at the same level. This is for quarter-wave spacing. For antennas a half wave apart, two sections of quarter-wave length coax can replace the eighth-wave sections.

Of course, with half-wave spacing, putting the switch on either position 1 or position 3 will have the same effect, merely changing from broadside to end fire.

For a really unusual method of feeding a pair of phased verticals, see Fig. 11. This array is used by Tom W7DND in Bremerton, Washington, with a parasitic reflector behind it and does a fine job. Note that the antennas are fed in phase by turning over the coax line, with one antenna going to the center conductor and the other to the shield. The half-wave line feeding antenna #1 puts that antenna back in phase with #2. Notice that no radials or ground connections are used.

In Fig. 12, the same array is used with a voltage feed in the center, using link coupling to the coax feedline. This is a sort of upside-down bobtail array.

I hope all this has not made phasing seem complicated, but it shows that that are many types of phased arrays, none of which are very complicated.

Pick one which suits your purpose and good luck. ■

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Can A $20 FM Rig Work?

—testing the VHF Engineering TX150 xmtr

Neither of us has ever written a review article before, but, after building several TX150s, we felt that other amateurs would be interested in our findings. The TX150 is a low-power two meter FM transmitter. It consists of three sections – a modulator, an oscillator multiplier, and a final multiplier output stage.

The first problem became apparent when the kits arrived. The only instruction is a single page showing the schematic, parts list, and layout. While this presents no great drawback for experienced builders, the beginner should realize that this is not a Heathkit-type project. The schematic has one omission – there should be a jumper from the junction of C12 and L1 to the junction of R9 and RFC2. The parts are of high quality, and the coils are prewound with the exception of RFC1. The beginner might have a problem recognizing RFC2; it appears the same as a 1/2-Watt resistor, but has a tan body. The board is glass epoxy, and the copper is tin plated for easy soldering. There are no mounting holes, so plan to drill some before assembly is started. The circuit board is only 25.4 mm by 115 mm.

Assembly is easiest if all the capacitors are mounted and soldered first, followed by the single jumper with its insulating tubing and the two rf chokes. Next, the coils are mounted and soldered after clipping off the small plastic tabs on the bases. Then the audio components and resistors are mounted and soldered. The resistors are mounted vertically with one end flush with the circuit board. R12 is mounted under the board. Finally solder in all of the semiconductors after double checking their orientation. The entire transmitter strip can be assembled in two or three hours.

Inserting an 18 MHz crystal, testing began. Tune-up is simple. Using a 50-Ohm, 1-Watt resistor for a load with a diode detector as in Fig. 1, the oscillator and then the final and output coils are peaked for maximum output. Table 1 gives the measured output power, input current, and total input power for supply voltages of 6 to 13 volts. Note that the output power with a 13-volt supply is an impressive 300 milliwatts.

What about harmonics? A series of tests were made using a Hewlett-Packard model 8554L spectrum analyzer set up as in Fig. 2. The photographs show that the multiplier frequencies are more than 30 dB down from the carrier. The second harmonic is 50 dB down, and the third is 48 dB below the carrier level. The relatively good harmonic suppression is due to the double tuned output. Next, a 2 kHz tone was applied to the microphone input. The modulation spectra are included in the photographs. Photo C is with 3

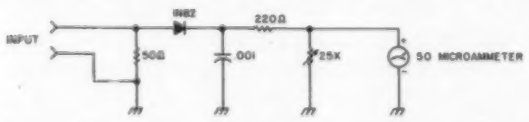

Fig. 1. Simple relative power meter for tuning the TX150.

Supply voltage	Current	Input power	Output power
13.0 V	0.11 A	1.43 W	300 mW
12.0 V	0.10 A	1.20 W	250 mW
11.0 V	0.095 A	1.05 W	200 mW
10.0 V	0.09 A	0.90 W	160 mW
9.0 V	0.06 A	0.54 W	100 mW
8.0 V	0.05 A	0.40 W	40 mW
7.0 V	0.03 A	0.21 W	12 mW
6.0 V	0.02 A	0.12 W	2 mW

Table 1.

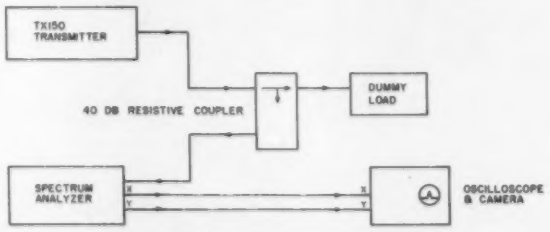

Fig. 2. Setup used for spectrum analysis.

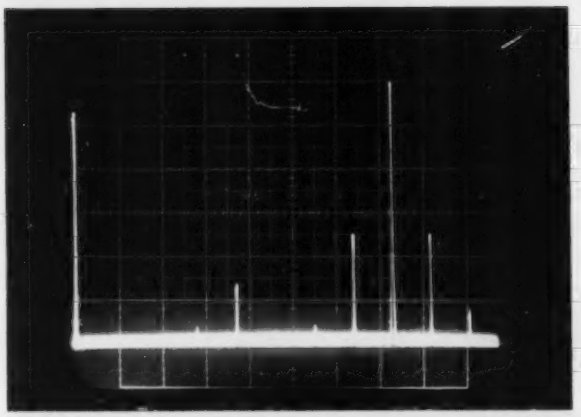

Photo A. Spectrum of TX150. Horizontal – 20 MHz/division; vertical – 10 dB/division. (Spike on left is 0 frequency mark.)

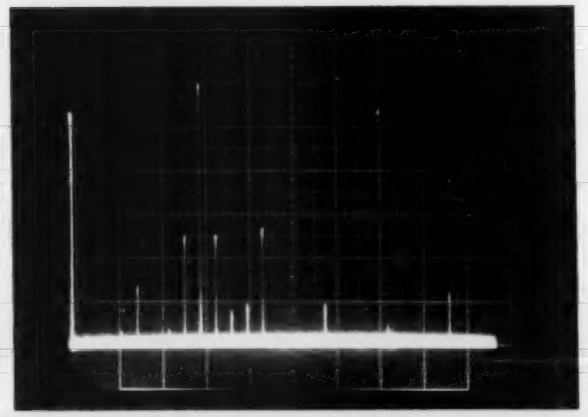

Photo B. Spectrum of TX150. Horizontal – 50 MHz/division; vertical 10 dB/division. (Spike on left is 0 frequency mark.)

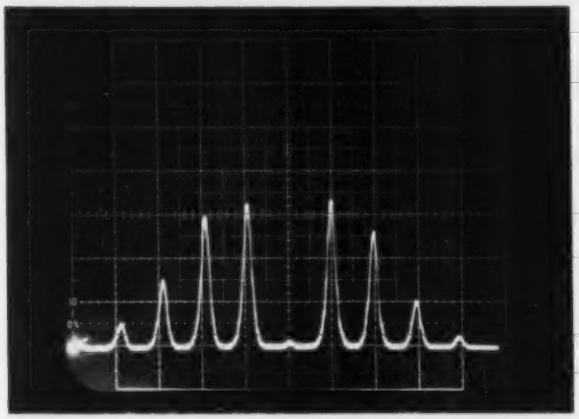

Photo C. Modulation with 3 millivolts peak-to-peak 2 kHz tone. Horizontal – 2 kHz/division; vertical – linear.

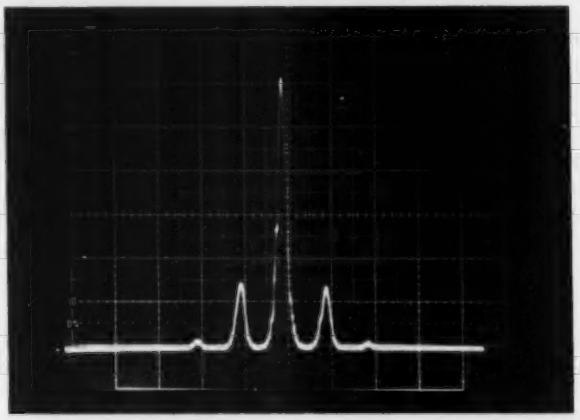

Photo D. Modulation with 10 millivolts peak-to-peak 2 kHz tone. Horizontal – 2 kHz/division; vertical – linear.

millivolts peak-to-peak input, and Photo D is with 10 millivolts peak-to-peak input. In Photo D, the carrier is near zero, or, in other words, the zero order Bessel function is zero, indicating a modulation index of 2.4. Since the modulation index is the ratio of the peak deviation to the modulating frequency, multiplying the 2 kHz tone by 2.4 yields a peak deviation of 4.8 kHz with 10 millivolts peak-to-peak audio input. This is close to the desired 5 kHz deviation. Distortion becomes evident when the audio input exceeds 20 millivolts peak-to-peak. The transmitter was run key-down for three hours with a 12-volt supply with no adverse effects. The final transistor got warm, but the output remained constant.

All things considered, the TX150 is well worth the $19.95 price tag. It is an economic answer for projects requiring a stable low-power transmitter strip that is very compact. With the present proliferation of repeaters, it presents an easy starting point for beginners to join in the fun on two meter FM. ■

LETTERS

from page 46

A method of discharging static buildup is certainly a necessity when working with MOS and many other devices, but it must be made so that the wearer's safety hazard is not significantly increased. The resistance must be located at the wrist so that accidental shorting of the grounding wire will not bypass the isolation resistance. The resistance value should be designed to limit the worst case current exposure to 1 to 2 milliamperes (i.e., the resistance value should be selected so that with the highest voltage in the work area passing through the isolation resistor and the person, assuming the person has zero resistance, the current in the circuit will not exceed 1 or 2 milliamperes).

The design must also consider the *voltage* rating of the resistors. A typical 1/4 Watt resistor is limited by a voltage rating of 250 V; therefore, several resistors in series may be required to safely handle a voltage equal to the highest voltage in the work area (don't forget those scope and video terminal HV supplies). Once the resistance value is determined and located at the wrist, the exposed braid conductors should be replaced by a good piece of test lead which is flexible enough but much lighter and will not be a source of short circuits as arm movements cause it to be dragged across items on the bench.

J. K. Galleher
Bowie MD

GETTING GEAR

There have been several articles written lately about the

Continued on page 55

David F. Miller K9POX
7462 West Lawler Avenue
Niles IL 60648

Hiss Exterminator

—an ear-saver for the TS-700A

If you rather enjoy monitoring noise while waiting for the local SSB gang to sign on for the evening or while parked on the DX frequency awaiting those elusive skip signals on 2 meter sideband, then this modification is not for you. Personally, however, I find continuous background hiss (noise) very distracting, and, after five or ten minutes of it, my ears seem to become numb (perhaps I spent too many years on FM where effective squelch circuits are commonplace). At any rate, I began looking around for a reasonably inexpensive solution to the problem, and the circuit to be described was the result of that effort.

I'm running the Kenwood TS-700A transceiver on 2 meter sideband (as are many others) along with Kenwood's VOX-3 voice operated transmit/receive switch, so it seemed logical to attempt to utilize as much of the existing circuitry as possible for the audio squelch feature.

If you're not familiar with the Kenwood VOX-3, it's a compact (1-5/8" x 5-1/8" x 4-1/2"), good-looking, and well-engineered box full of electronic goodies, which is directly usable with the TS-700A and adaptable to other rigs. Its price qualifies it as one of the best bargains in town.

It has "VOX gain," "anti-VOX gain," and "delay time" controls all up front, and it derives its operating voltage from the mating transceiver via a 9-pin miniature tube socket (shades of the good old days) located on the rear apron. But, best of all, it also has about half of the circuitry that's needed for an audio squelch system, namely, the anti-VOX audio detector and its associated amplifier. What I added in the circuit diagram shown is a Darlington connected relay driver amplifier, a sensitive (and quiet) reed relay, and a way to reroute the audio to an external speaker through this circuitry. Yes, an external speaker must be used when the audio squelch feature is desired (you're probably already using one, though), and a miniature 1/8" phone jack is added to the rear apron of the VOX-3, next to the 9-pin socket, for this purpose. A dummy 1/8" miniature phone plug (the one supplied with the TS-700A) is inserted in the "external speaker" jack at the rear of the TS-700A in order to disable the built-in speaker when using the audio squelch feature.

For purposes of circuit operation details, speaker level audio is tapped off pin 1 on the 9-pin VOX-3 rear socket, fed through the normally-open contacts of the reed relay, and fed back out to the external speaker via the new 1/8" phone jack. The 13-Ohm, 1-Watt resistor shown as R20 acts as a constant load for the audio output stage of the transceiver. The only control on the VOX-3 that has any bearing on the audio squelch circuitry is the anti-VOX gain, which sets the threshold of the squelching action. The hold-in time of the reed relay is determined by C11, the 500 uF electrolytic capacitor across the relay coil. Diodes D9 and D10 will protect the transistors in the relay driver stage from transients, and R21 drops the Vcc (operating voltage) to about 12 V dc,

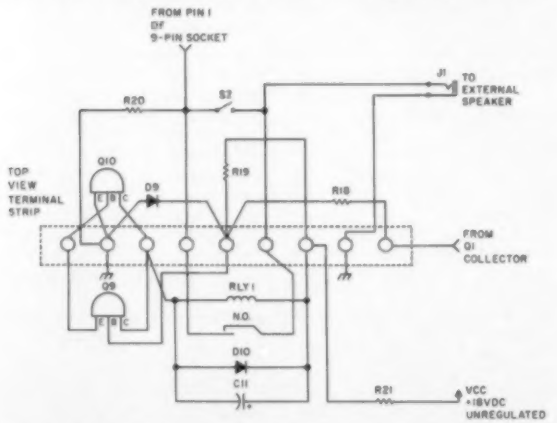

Fig. 1. Pictorial diagram for the VOX-3 audio squelch circuit.

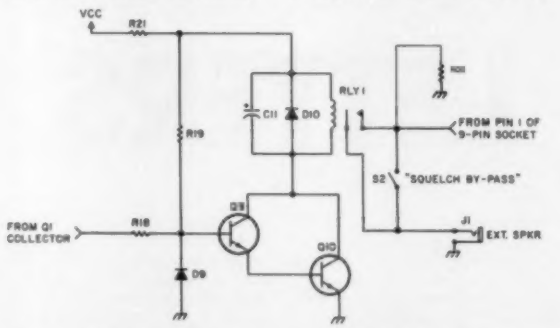

Fig. 2. Schematic diagram for the VOX-3 audio squelch circuit.

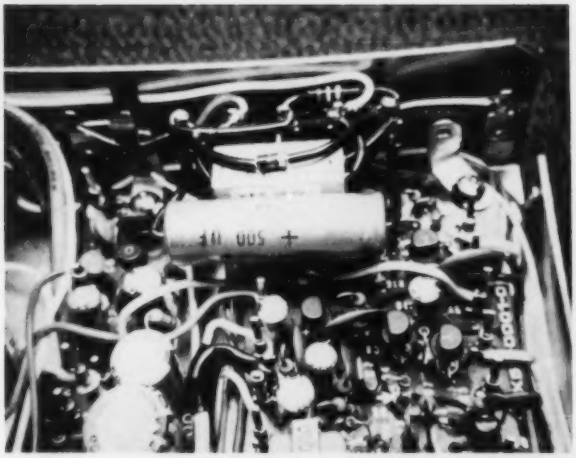

Photo A. Top view of VOX-3 interior showing audio squelch modification.

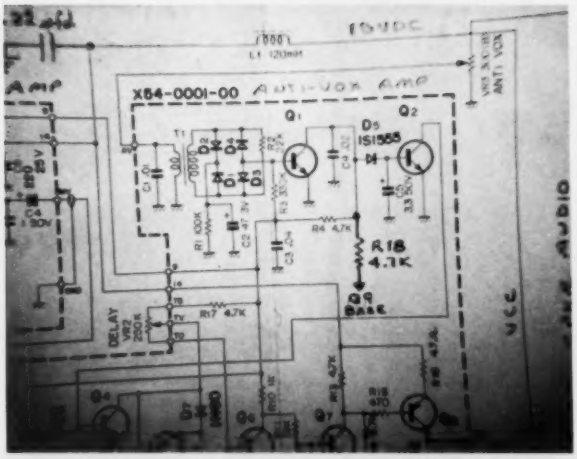

Photo B. Schematic diagram supplied with VOX-3 showing tap-off point for new R18 at Q1 collector.

inasmuch as the Vcc available from the TS-700A is about 18 V dc when operating from 120 V ac mains. R18 and R19 are biasing resistors for the Darlington connected relay driver transistors, and the squelch bypass switch S2 (which I mounted on the front panel midway between the anti-VOX gain and delay time controls) shorts the normally-open contacts of the reed relay when no squelch action is desired or when using the VOX-3 as a VOX unit. Just in case you've wondered, this modification does not hinder you from using the VOX-3 in its old way. Simply activate the bypass switch and operate it as you always have in the past. None of the wiring or parts layout is critical, so feel at ease with whatever physical layout changes you may wish to incorporate. The photograph of the mounting terminal strip (with all parts installed) and the pictorial layout drawing show how I adapted the circuit to my VOX-3. A 9-lug terminal strip was used, which fit very neatly and required no additional drilling or mounting hardware. The existing circuit board mounting screws are used, and the result is a mechanically rigid finished product. You must remove the four mounting screws from board #X54-0001-00, carefully turn it over, and solder a wire to the Q1 collector circuit foil pad, but this is the only connection that cannot be made from the top of the unit. As mentioned before, speaker audio is picked up from pin 1 of the 9-pin socket; this same socket will provide Vcc on pin 9 and ground on any of pins 2, 4, or 7.

In order to give you an idea of what to expect in the way of control settings, I normally run all three of the VOX-3 panel controls at the 12 o'clock position when operating VOX control. When using the audio squelch, the anti-VOX gain is run at 10 o'clock with the TS-700A "af gain" at 9 o'clock. The reed relay holds in about 1-1/2 seconds between words on an S9 signal using the 500 uF across its coil, and the unit will unsquelch with a signal too weak to register on the S-meter when standby monitoring with the noise blanker activated.

No claims of engineering excellence are made for this circuit other than that it does work, as WB9DRA and I can testify, and, after all, that's the bottom line! ■

Parts List

C11	500 uF, 35 WV dc electrolytic
D9	1N4148 diode
D10	1N4005 diode
J1	1/8" miniature phone jack
Q9, Q10	2N4409 transistors
R18	4.7k, ½ W resistor
R19	560k, ½ W resistor
R20	13-Ohm, 1 W resistor
R21	220-Ohm, ½ W resistor
Rly 1	12 V dc, 400-Ohm coil relay with normally-open contacts (Elec-Trol RA30011121 or equivalent)
S1	SPST miniature toggle switch

LETTERS

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best way for police agencies to trace stolen, lost, or misplaced equipment back to the rightful owner when recovered. I have been waiting for a police officer to write something on the quickest, simplest, and most sure-fire way, but so far I haven't seen anything about the right way to do it. I am no authority on the subject, but I work in the Communications Service of the Texas Department of Public Safety (State Police), and have had some experience trying to trace equipment.

You would be surprised at the amount of electronic equipment gathering dust in the evidence rooms of the police departments across the country because they could never determine who the rightful owner is. Most of it will end up being sold at public auctions after being held for a period of time.

A serial number or social security number is of no use in trying to trace a piece of equipment to its owner. It could probably be done with a serial number if all the sales of the item were recorded, but no police dept. will go to the time or trouble to try tracing anything with the serial number. The only useful purpose of the serial number or social security number is to identify a piece of equipment when and if the owner accidentally comes across it and says, "Hey, that belongs to me." The serial number is also used to enter stolen equipment into the National Law Enforcement Teletype System computer (NLETS).

The best way to identify your equipment is with your driver's license number. In front of your DL number, put the two-letter

Continued on page 59

THE INCOMPARABLE SYSTEM 3000A

HAS A BUILT-IN $450 DISCOUNT

$450 discount? When you buy SYSTEM 3000A, you're getting $1000+ worth of unequaled performance for $549. Examine the unique features of SYSTEM 3000A, add up what it would cost to duplicate (if you could) this small, feature-filled radio and you will quickly realize what a remarkable bargain you're getting. By marrying the best transceiver available to a microcomputer-controlled PLL synthesizer, **Edgecom** has produced a 2-meter FM system with such unique and incomparable operating flexibility it is almost unbelievable. A few of the extraordinary features of SYSTEM 3000A found in no other transceiver are:

- **TWENTY FRONT-PANEL-PROGRAMMABLE CHANNELS.** *Just dial in the frequency and transmitter offset, press the Enter switch and you're in memory. Two channels are instantly recallable as priority channels at the flip of a switch.*
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- **MEMORY-CHANNEL MONITOR.** *Lets you operate on one frequency while monitoring one or more others.*
- **ANY TRANSMITTER OFFSET.** *In addition to the standard ± 600 kHz you can program any offset from 5 kHz to 4 MHz.*
- **FULL TWO-YEAR WARRANTY.** *Every SYSTEM 3000A is warranted to be free of defects for two years. And it is American made so servicing is no problem.*

Combine these, and the other unique operating features of SYSTEM 3000A with a receiver of unsurpassed selectivity and intermod performance, a transmitter that produces over 25 watts of (adjustable) power and you have a fantastic $1000+ transceiver for the remarkable price of $549.

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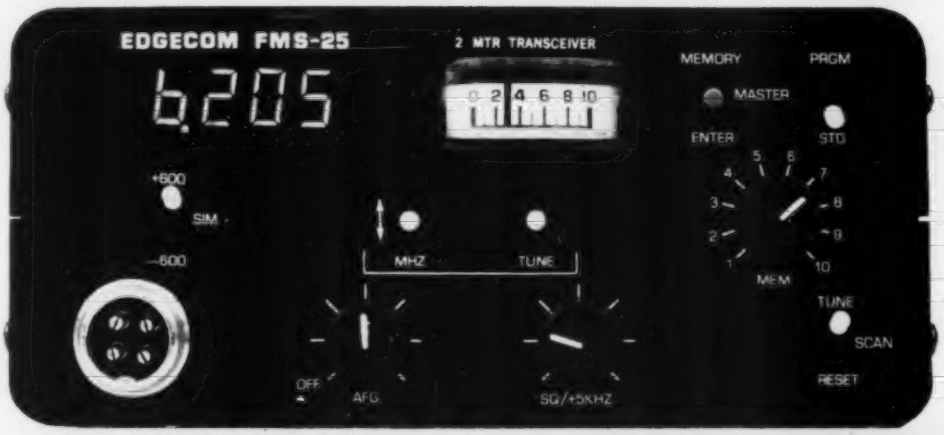

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Instant Engraving

—to protect your equipment

It has been shown that those who participate in one of the "operation identification" type of programs are less likely to have their property ripped off, and, for those who still manage to lose things to the midnight suppliers, the chances for recovery are improved if the property has been indelibly marked. Since it isn't always convenient to borrow an engraving tool, here is a simple way to make a throw-it-away marking tool.

This system leaves a rather permanent mark, as may be seen in Photos A, B, and C. It may not be as deep as the one made by an engraver, but it seems to weather quite well.

The main ingredient for

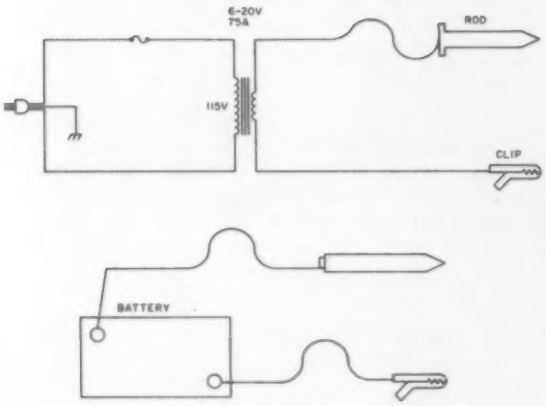

Fig. 1.

Photo A.

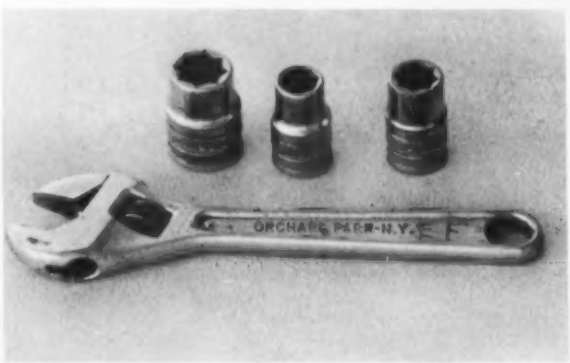

Photo B.

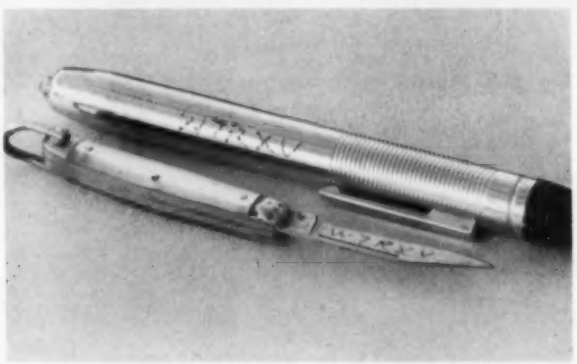

Photo C.

Photo D.

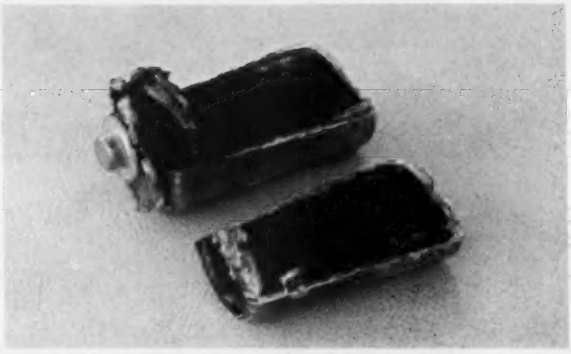

Photo E.

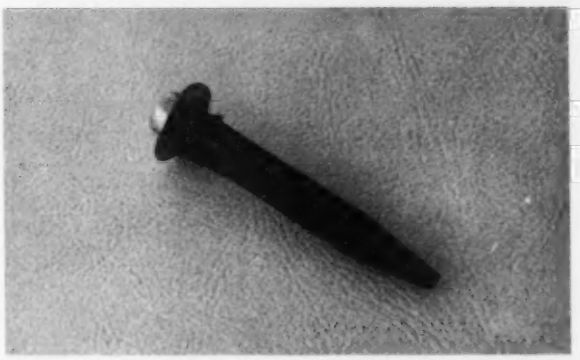

Photo F.

Photo G.

this system is the carbon rod from a used size-D flashlight cell. As Photo E shows, a hacksaw may prove most helpful in removing the rod from its container. After the rod is removed and cleaned up, it is fed into a pencil sharpener. The point should be medium fine. (Note Photo F.)

Reasonably heavy leads are connected to a suitable power source with the other ends connected to the cap on the rod and the item which is to be marked. If the cap becomes detached, the wire may be wrapped around the top of the rod and held in place with pliers while it is being used.

The power source may be either ac or dc. A filament transformer rated at five Amps or more and able to deliver from 6-18 volts would be a suitable power source. If there is a heavy-duty dc supply around the shack, that will work, too. A 12-volt car battery would be nice, but not necessarily convenient. In any case, the voltage should be kept below the point where an arc can be struck and maintained.

Since a small amount of the carbon rod may be oxidized during the marking process, this procedure should be done in a relatively well ventilated area.

Note the glowing rod in Photo D. This gives an idea of what the system looks like in action.

If you are something less than artistically inclined, then you may want to practice making your mark on a piece of scrap material until you get the hang of it.

Fig. 1 gives the diagram for those who are technically inclined. ■

LETTERS

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abbreviation for your state and the letters DL. Example: TX DL 3193921. It takes about three minutes to trace any person anywhere in the continental United States through his driver's license number, with the use of NLETS, which is a nationwide network of computers that you wouldn't believe. There is one exception: The state of New Mexico requires a person's full name and date of birth before you can get a computer hit on his driver's license. Of course, you should have your current address on your driver's license, which is required by law in most states.

The number should be on the outside of the case as well as the inside. Some of our better police officers don't have the technical ability to take the case off equipment to check inside for identification numbers.

This won't keep your equipment from being stolen, but it will keep it from sitting on a shelf in a back room of some police department because they couldn't determine who the owner is.

Scott McDowell
N5SM/WB5JJN
Amarillo TX

SPEAKING OF QRM

I would like to take friendly exception to WD5HYN's letter (May issue) concerning QRM. In 16 years of operating, I have rarely, if ever, heard deliberate interference to any QSO. I believe that most QRM is a result of propagation anomalies, beam antenna patterns, and other phenomena, including our very crowded bands.

Take, for example, a ham transmitting on the HF bands from New York City with 1000

Continued on page 60

The New, Improved Automatic Thermostat

—adding a night thermostat

James C. French W9YBU
Country School Rd.
Dundee IL 60118

December, 1976, set a low temperature record not matched in the last 96 years. The gas company warns that gas bills may be as much as 45% higher than last year. So, here in the midwest, "An Automatic Thermostat," by George R. Allen W1HCI in the January, 1977, *73*, presented an urgent and immediate project.

I made certain modifications which simplify his system and offer a fail-safe operation.

I used a small timer called a Time-All™ to cut the system over at night to a night thermostat. A 120 V ac relay, SPDT, shorts out the night thermostat during the day.

During daylight hours, the normal thermostat controls the temperature. At night, the night thermostat is put in series with the day thermostat. The night thermostat is set to open when the night temperature has reached, say, 55°. If the thermostats are in series, the night thermostat will set the temperature, since it opens before the "day" thermostat.

During the day, the relay will short out the night thermostat, and it will effectively not be in the circuit.

The night thermostat should be mounted in some area which is removed from the furnace but not affected by drafts or the outside temperature.

The Time-All timer is plugged into any convenient ac outlet. The 120 V ac relay is suitably mounted in a cabinet near the timer. The relay is wired so that, when the timer is off, the relay (de-energized) shorts out the leads to the night thermostat. See Fig. 1. When the timer kicks in, the relay pulls in, and the short is removed from the night thermostat. It then controls the temperature.

Settings for temperature may have to be by the cut-and-try method to achieve the overall house temperature you wish for the night.

The timer has a switch which will defeat its timing function when you wish a warmer temperature late at night or early in the morning. Should the timer fall out of the ac outlet, or should the fuse on that circuit blow, the day thermostat remains in control of the house temperature.

Good sleeping and a reduced heating bill to you. ■

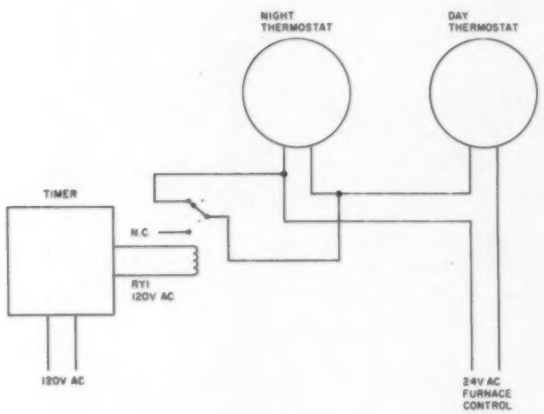

Fig. 1.

LETTERS

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Watts and a good tribander aimed at Miami. While a good portion of his signal is being radiated in a 15° fan along the New York-Miami axis, some of that power is also being radiated around the other 345° of arc. Now, let us postulate another ham, say in Seattle, with a beam (or a dipole) aimed at Chicago, in QSO with a W9 with a beam and 250 Watts. The residual signal of the New York City ham may, due to propagation conditions and the fact of higher power, be as strong or stronger in Seattle than the W9's signal, yet, due to the orientation of the New York ham's beam, he will be unable to hear either the Seattle or the Chicago ham! In addition, the Chicago ham, with the beam, will probably hear very little of the New Yorker's signal due to the New York ham being in the deepest part of the null of his beam.

Changing band conditions, particularly during heavy sunspot activity and during dawn and dusk periods on 20, 15, and 10 meters, can also play havoc. Every ham, I'm sure, has had the experience of being in solid QSO with a distant station, and, upon turning it over, has heard nothing or has found himself or herself in the middle of another QSO between two hams in another part of the country (with one of these two complaining about the QRM). A quick study of the propagation characteristics of the HF bands will show that reliable communication (as shown by the Maximum Usable Frequency) is highly dependent upon time of day and the period of the sunspot cycle. This can be worked backwards, too: The usable *distance* of any given *frequency* varies, depending

Continued on page 63

YAESU'S NEWEST RECEIVER
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Stability: Less than ±500 Hz drift for any 30 minute period after warmup.
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Selectivity: SSB/CW ±1.5 KHz (−6dB), ±4 KHz (−50dB) AM ±3 KHz (−6dB), ±7 KHz (−50dB)
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Weight: approximately 7 kg.

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Give 'Em A Break

—with a cheaper repeater beeper

Bob Thornburg WB6JPI
13135 Ventura Boulevard
Studio City CA 91604

Active open repeaters tend to develop a strain of users who acquire the knack of holding a conversation with such enthusiasm that the exchange is so fast, back and forth, that no one can break in. Through the years, repeater designers have attempted to negate this discourteous behavior by providing a short delay between the end of a transmission (squelch tail) and the reset of the time-out timer. This technique requires that the short delay must be observed by the users in order to reset the timer, time out, and preclude being turned off. But the quick-thumbed users still continue to exercise the rapid exchange with a kind of wily second sense as to when to pause to reset the timer. For the guy in the station waiting to break, the random and unpredictable pause is impossible to catch, and, in his frustration, he will probably double with one or the other of the agile button-users. The doubling usually obliterates the audio of both the parties involved and, other than attracting some attention for the breaker, does little for smooth operation.

That's one problem; here is another. Let us assume that your repeater is co-channeled with another somewhat distant repeater. When your repeater drops off, the other is clearly audible. If your delay is short between COR action and carrier drop-off, it is often difficult to distinguish between the end of a conversation on your repeater and conversation on the co-channel repeater. This leads to some pretty humorous statements, but it's not often enough to offset the confusion and resulting inefficiency. The solution is to lengthen the drop-off delay and insure that the squelch tail is clearly noticeable and quite distinctive by the resulting quiet pause.

That's two problems; here's a third. If your repeater indicates reset of the timer by dropping the carrier, then, for an active repeater, the carrier is being switched on/off a huge number of times each day — say it is in use for 15 hours per day and keyed on an average of once per minute. The carrier is switched about 1,000 times per day. This incessant switching is hard on the transmitter and power supply and results in early failure and poor reliability of the associated components.

There exists a simple solution to these problems. First,

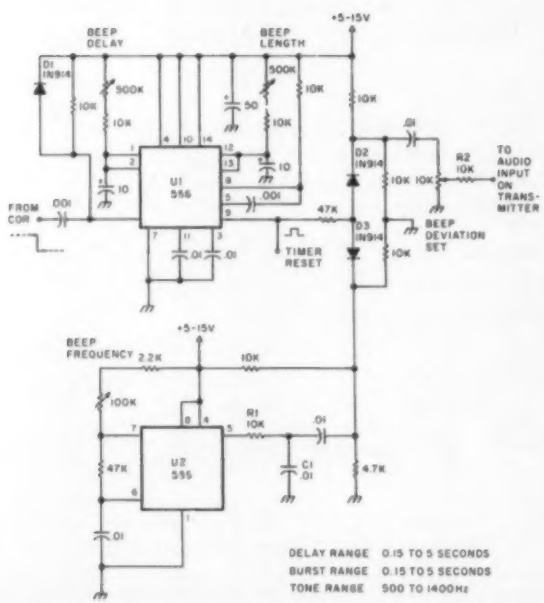

Fig. 1. Beep schematic.

set the carrier dropout at about 5 seconds. If the repeater is not in use for five seconds, then it goes away. It perhaps could ID for the last 1-2 seconds of this delay. Second, reset the timer at one-half second after the COR opens, and indicate that the timer has been reset by transmitting a half-second tone. This beep tone clearly indicates to the user that the timer has reset and the one-half second delay between the squelch tail and the tone is ample for breakers to use. For the initial applications, the reset time should be longer — say, one second to "train" the users — but very soon the rhythm of the operation is learned and one-half second has been found to be adequate. The tone should be between 600 and 1000 Hz at about 1-2 kHz deviation.

The beep tone solves the first problem described above by a physiological phenomenon. To not wait for the beep is treated by the users as a cardinal sin. No matter how sloppy operation becomes, it is unthinkable to not wait for the beep. If someone "beats the beep," they are immediately chastised or "educated" by their fellow users. The peer pressure has been very effective, mainly because the beep tone is a clear and unambiguous indicator and to jump the tone is an obviously discourteous act. To continue to fail to wait is clearly an overt and malicious act.

The second problem is solved since the repeater doesn't drop off during a continued conversation. It requires five seconds of no talking to drop off, yet the beep tone allows full and orderly exchange between your users without inadvertent interjections by your co-channel.

The third problem is also solved in that the repeater doesn't drop off nearly as often. Instead of 1,000 times per day, the number is reduced to 30-50 times per day. The reliability is significantly increased, even with the added complexity of the beep circuitry.

Once the above basic beep concept is comprehended, there are several extensions in usefulness that can be discussed. The pitch of the beep is unique to one repeater and quickly identifies to someone who casually tunes in that it is this repeater he has stumbled upon. This uniqueness can be extended by using a chime tone or other clever sound for your "beep." We have one repeater in southern California (WR6AFR) that sounds like a broken watch spring.

Another clever idea is to do away with the squelch tail. We're all used to the sound, but imagine how that blast of noise called a squelch tail must sound to the uninitiated. Present technology allows the repeater to eliminate (without degradation in performance) the squelch tail. But, without a tail, the user doesn't know when to talk. Why not two beeps, one instead of the squelch tail and one at some different pitch on the timer reset. Done right, it would sound like a front-door chime and send casual observers scurrying to answer.

The pinnacle of useful beeps is that of WR6ABN. (See *QST*, May, 1974.) This beep consists of two simultaneous tones. The high tone alone indicates that the previously received signal was high in frequency; the low tone alone indicates that it was low in frequency. Both tones together mean the user was "on channel."

Beeps are not great saviors of all repeater problems. They tend to create problems, too, one of which often overshadows any benefits. We are almost all aware of the user syndrome known as kerchunking. This obnoxious procedure is to continuously key up the dormant repeater just to hear it come on. Now give this astute individual a beep to play with, and he will drive you and other monitoring people batty. Kerchunk-beep, kerchunk-beep, kerchunk-beep, etc., and soon you're ready for a complete rebuild. If the repeater is busy enough, he doesn't have time to play with his new toy and will do other things to entertain himself.

The beep solves some problems, and it creates some new ones. But such is life. At least the new ones are new and different, and maybe this is progress.

Beep Circuit Description

The circuit diagram for a beep generator is shown in Fig. 1. The input signal comes from the COR used to turn on the transmitter. The signal here is before the 5-second time-out timer. A negative-going edge during the squelch tail is satisfactory. The starting level can be almost anything, as long as it goes below 2 volts to start the beep cycle. The diode, D1, will protect the circuitry even for 2-300-volt tube COR levels.

The 556 dual timer, U1, is triggered by the COR. The first section times the delay from COR to beep, and the second section, triggered by the end of the first section timing, generates the beep gate pulse. This pulse enables an analogue gate consisting of D2 and D3. The beep tone is continuously generated by U2 to insure that it won't change frequency during the beep. This also allows some filtering on the tone to remove the sharp corners. This simple filter consists of K1 and C1. The output level can be set by the beep deviation set, and R2 insures the beep circuit will not load the other audio circuitry. The output level of the beep is variable from zero to about 1 volt rms for a 12-volt power supply.

Care should be used in construction to insure that the continuously running tone generator, U2, does not couple into the low-level audio circuitry where it will appear as an annoying tone. ■

LETTERS

from page 60

upon the ionization characteristics of the various layers of the ionosphere.

Finally, it occurs to me that, through no fault of the operator, a well-intentioned ham can listen on a frequency for several minutes before calling CQ, and, hearing nothing, go ahead with his call. This operator, unless he can hear both sides of a QSO, has no way of knowing that there is a 5 wpm QSO going on the frequency between two Novices (or between two rusty old-timers).

So, let's not be too quick to yell "interference" when our QSOs get clobbered. Ninety-nine plus percent of the time there is no deliberate interference. Chalk it up to experience, use the opportunity to improve your "difficult copy" technique, move up or down a few Hertz, or shut the thing off and go watch the evil eye in the living room until the band opens up.

And, speaking of QRM, did I ever tell you about *my* Novice days, working rockbound on a 7125 kHz rig with a Hallicrafters S-20R Sky Champion with a Q-multiplier . . . ?

Warren S. Kirkland WD6EZO
Security CO

KIM CW

Scanning a bibliography prepared by Wm. Dial, *Micro*, April-May, 1978, I ran across the reference to "Receive CW with a KIM," *73*, Nov., 1977. Having written a send/receive program myself (*Micro*, April-May, 1978), I was interested in the algorithm used by Shattuck and Schmidt.

Continued on page 65

Karl T. Thurber, Jr. W8FX/4
233 Newcastle Lane
Montgomery AL 36117

It's Flora Clock!

—and all is well

One day, while visiting a local supermarket with the XYL, I happened upon an eye-catching display of Rubbermaid "Windowsill Planters" which, I thought, if turned upside down, just might make dandy equipment consolettes for miscellaneous small projects that might not require mounting in regular minibox or other shielded equipment cabinets.

The display I saw featured a variety of sizes, ranging from quite small to full windowsill size, in several different woodgrain colors, including walnut, tan, and green. I selected a walnut unit, 3¼" x 5" x 3" (No. 3451), for experimentation and set to work just the *opposite* way from regular construction practice, i.e., starting with a good-looking box and finding some gadget to build into it to put the little gem to good use!

After a bit of thought as to what was missing or otherwise needed at my operating console, I decided to make use of the planter (after nearly having it usurped for its intended purpose by the XYL) by installing a digital clock "atop" it (when viewed upside down) and installing a small source of 9 V dc (nominal) inside the box to power accessories and to provide a source of power for an LED "blinky."

I turned the planter upside down and installed some very small rubber mounting feet on each corner. The result was a very attractive consolette-type enclosure which would be a convenient housing for this or any similar project, such as calibrators and other applications where shielding isn't important. The flat upper surface of the box (when turned upside down) provides a convenient mounting place for a small LED readout digital clock. I used a Babylon Electronics "Space Age" digital clock, which is a completely self-contained miniature unit featuring a large 4-digit LED display and which comes with its own line cord-type ac transformer. This unit, which uses the popular 5314 clock IC, comes with easy-to-follow instructions and goes together quickly. It is particularly adapatable to ham shack use as it can be set up for either 12- or 24-hour time format. Although it does not display seconds directly, seconds are readable as a specially-coded dot pattern readout between the hours and minutes groups of LED digits. While I built the Babylon unit, a similar clock has recently been introduced by Hobb-Y-Tronix, Inc. (Box 511, Edison NJ 08817), known as the "Super Compact," a unit featuring .4" LEDs, interchangeable 12- or 24-hour format, and an optional temperature-indicating front panel. Either clock should be suitable; in fact, any clock which will fit the 2¼" x 4¼" "table" atop the flower box will do. The clock is simply epoxied into place, and the power cord to the ac transformer is run through a hole drilled in the top of the box.

The inverted flower box proper houses the ac transformer for the clock, the LED blinky kit, a 6 or 9 V dc adapter to power the blinky, an SPST switch for the blinky power, and a miniature phone jack supplying power for any accessories that I may desire to run off the consolette. The ac transformer and dc adapter are epoxied into place inside the box, while the blinky module is supported by the two LEDs protruding through the front of the cabinet.

The blinky kit I selected was the BL-1 "Mini-Kit" sold by Ramsey Electronics, P.O. Box 4072, Rochester NY 14610. The blinky alternately flashes the two LEDs furnished — the flashing rate being determined by the values of C1 and C2 (referring to the manufacturer's instruction sheet). Larger values of C1 and C2 cause the blink rate to decrease, while smaller values will increase the rate. The blinky kit runs off source voltages as high as 20 volts without damage, though a 9 V dc power source was most convenient for me due

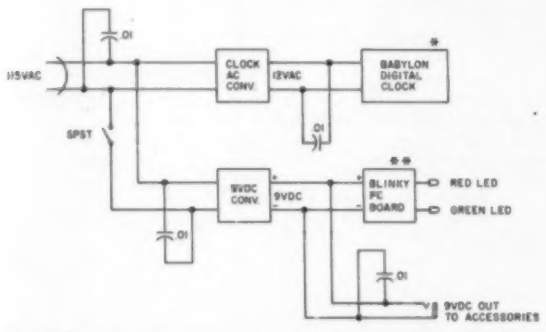

*Fig. 1. Flower-box console. *Babylon "Space Age" digital clock kit or equivalent, such as the Hobb-Y-Tronix "Super Compact" kit with ac transformer. **Ramsey BL-1 blinky module or equivalent (see alternate circuit of Fig. 2).*

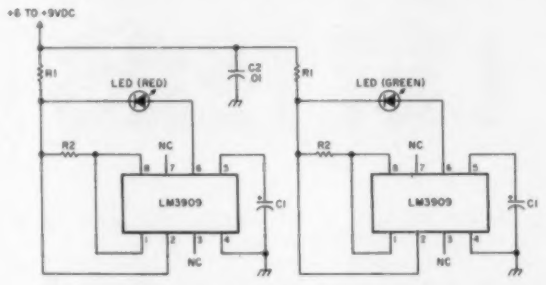

Fig. 2. Alternate home brew blinky module. C1 = 350 uF; R1 = 1000 Ohms, ½ W; R2 = 1500 Ohms, ½ W: all values nominal. Separate LM3909 circuits allow independent flashing.

to the availability of an old (but serviceable) 9 V transistor radio battery eliminator. Substituting a green LED for one of the two red ones furnished with the kit adds a bit of class, and increasing the values of C1 and C2 to about 75 uF slows down the blink rate to a reasonable one with 9 V dc applied. No special precautions are required when building the unit on the PC board supplied, other than the usual necessary care in assembly when dealing with highly miniaturized units. Hobb-Y-Tronix also sells a similar blinky flasher kit which uses a 555 timer and is specifically designed to work off 9 V dc. I used a 100 mA dc adapter, though any 6- or 9-volt unit should work well with either module as only a few mA are required. At the price levels involved (less than $3 for either kit), it hardly pays to make up the PC board for a completely home brew blinky, though the circuit shown in Fig. 2 could be used. Both ac and dc lines should be bypassed with .01 uF disc ceramic capacitors to suppress any floating rf which might seek a home in the digital clock or blinky board. Also, if a hum problem is encountered when running accessories off the unit, try connecting a high-value (500 uF) electrolytic capacitor across the output, observing correct polarity. Whichever blinky circuit is used, the 9-volt power adapter and ac transformer for the digital clock easily fit into the shell of the inverted flower box and can be epoxied into place. Two small holes are drilled in the front of the box to allow the two LEDs to protrude through the front. A hole is drilled in the front for mounting the SPST mini toggle switch, and holes are drilled in the rear of the box to accommodate the accessory miniature phone jack and 115-volt ac power cord. A custom nameplate (which can be made at any nameplate engraving service or at the next local hamfest) indicating the station callsign may be glued to the front panel to complete the installation.

One caution when scrounging a dc adaptor: If accessories are to be powered by the unit, make sure that the adapter used doesn't have one side of the dc output line connected to the ac line. Some of the cheaper imports may and should not be used, as they would present a shock hazard.

While, admittedly, this project started out as little more than a novelty, putting it together was a good deal of fun, and I have found that it is actually quite attractive and draws a good number of compliments. And, best of all, no one has yet guessed that the cabinet is a flower box!

The larger boxes are a bit oversize for typical ham shack applications, but the smaller units such as the one I used have good potential. They are just about right for small construction projects such as clock housings, high-intensity lamp bases, selector switch boxes, and the like. The fibrous composition plastic material is a bit difficult to work with, however, and is not very suitable for intricate drilling and punching. Just keep what you try to install in the boxes simple, and you'll be rewarded with a good-looking finished product certain to add an extra touch of class to the shack. ■

LETTERS

from page 63

There are some fundamental differences between our algorithms. Our dot-dash, element space, character space, and word space decisions seem to be basically the same. However, my program rejects as false any mark elements (key down) less than one-half the dot length, giving additional noise discrimination on the air.

There are a few other points of comparison which I would like to make.

1. They have a wide variety of display formats; my program requires some kind of video module to convert ASCII to a video format and display it on a CRT.

2. My program has greater time resolution for character decisions. Their basic time unit was about 4 ms and mine was 1 ms. This probably makes no difference until excessively high code speeds are reached.

3. They use an automatic calibration routine which tracks variations in code speed. I enter the code speed from the keyboard, and the 7-segment display on the KIM indicates whether the speed is too slow or too fast. In an earlier attempt at a Morse code reader, I found that static crashes tend to foul up auto-cal circuits.

The point in writing this letter, in addition to bringing attention to some possible variations and improvements in CW receive programs, is to suggest that someone with the appropriate equipment try both programs "on the air" and make evaluations and suggestions for improvements. I will be glad to furnish an interested individual with a reprint of my

Continued on page 69

Henry H. Cross W1OOP
111 Bird's Hill Ave.
Needham MA 02192

Build Your Own Digital Dial

—great update for your receiver

Every shack needs a general-coverage receiver, if only to tune down to find where the harmonics are likely to be coming from. If your general-coverage receiver is anything less than an R-390, it needs a digital dial. A readout to even kHz will be a great help, provided the last digit is useful, rather than indecisive.

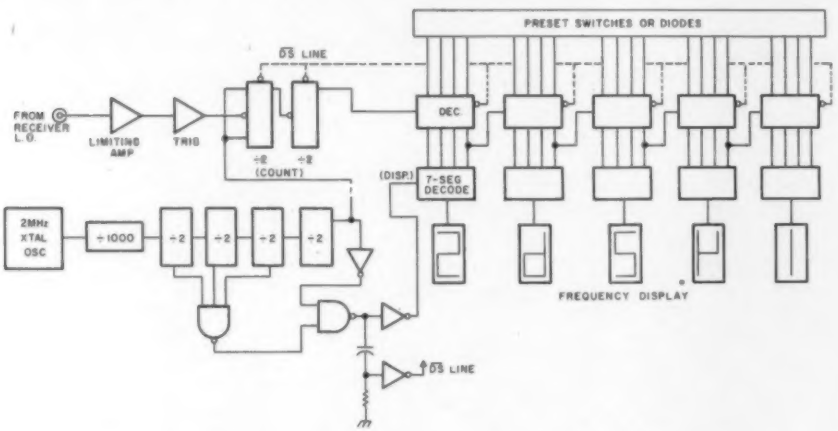

Fig. 1. Digital dial logic diagram. Frequency display is shown from back.

An article by Jon Hagen in the December, 1972, *QST* told what to do and how to do it (except for how to make LED displays work right), and my unit was based on that, on his personal comments (he talked me into building one), and on a lot of cut and try on my part. Some of the features that I have tried aren't included here, as they are not worth the effort involved. But what is in this article is essential to make a useful display. Albert Ingalls cautioned amateur astronomers "not to make their last telescope first," and, unless you are a digital nut rather than a ham or SWL who needs a digital dial, I suggest keeping things simple. If you want something better, see Jack Regula WA3YGJ's system in the October, 1976, *73* (corrections 5/77) and something similar in the ARRL 1976 *Handbook* as part of a communications receiver. Regula's article uses a multiplexed display with a CMOS driver suitable for common-cathode LED numbers. Mine uses 7447s and common-anode displays, and the two other articles avoid the issue.

The difficult questions involve human engineering (now I need reading glasses for the red numbers at arm's length, but not for green or yellow!), where to put the readout (close to the knob you turn), and how to keep the digital hash in the box and out of the receiver. If the box is put together with a dozen screws or more, the

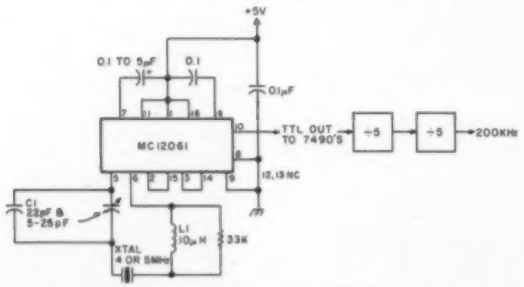

Fig. 2. An IC 5 MHz oscillator (Motorola MC12061). This IC consists of an ECL oscillator, a buffer, and an ECL-TTL converter. If the crystal won't pull to frequency, modify C1 or L1.

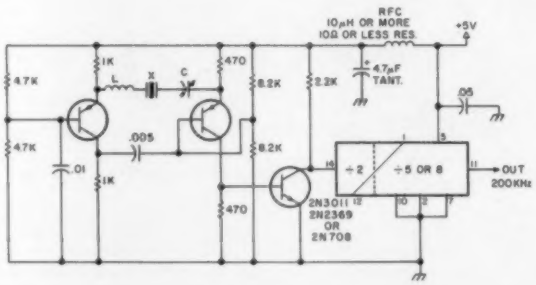

Fig. 3. 2 MHz crystal oscillator. PNPs — 2N3012, 2N3906, 2N4121, and 2N963. For 2 MHz crystal — L = 10 uH, C = ~ 30 pF.

only way for hash to get out is via the readout window (mine is 0.787 by 3 inches), the input coax, or the ac line. The input amplifiers should be somewhat separate from the rest of the counter, and the lead to them should be coax inside as well as outside the box.

Because the 7447s are not multiplexed, the 7-segment output lines can be bypassed at the LED end with up to .01 uF, if needed. I found that the ac line was what took the effort and I didn't filter the display.

It is important to realize that the dial will read right, even if you have two-dial electrical bandspread or a helipot-and-varicap fine tuning system. Also, as long as you read the LO frequency, the fact that it drifts a few kHz is something not easy to notice. Subjectively, your receiver no longer drifts (how to save $495).

The preset system is similar to that used in the GLB synthesizer (up to 15 diodes per wired-in frequency), and any number can be supplied, or you can use thumbwheel switches, BCD switches, or toggle switches. For my purposes, an SPDT center-off type (as shown) takes care of LO high, LO low, and operation as a straight counter in the "off" position. Experience suggests that the last digit preset might be best brought out to a panel switch, as not every "455" i-f is on that exact frequency.

For antiblink purposes, Hagen used an undisplayed decade. Mine divides by four, so I can use J-K gating and cycle a bit faster (125 blinks per second, rather than 50). No latches are used, although they would be needed if you read down to 100 Hz. Count period is 4 milliseconds, display 3.5 milliseconds, reset takes two microseconds, and the rest of the time is wasted.

Because the preset ("data") inputs are on 0.02 percent of the time only, the input pull-down resistors can be 4.7k or higher, if .01

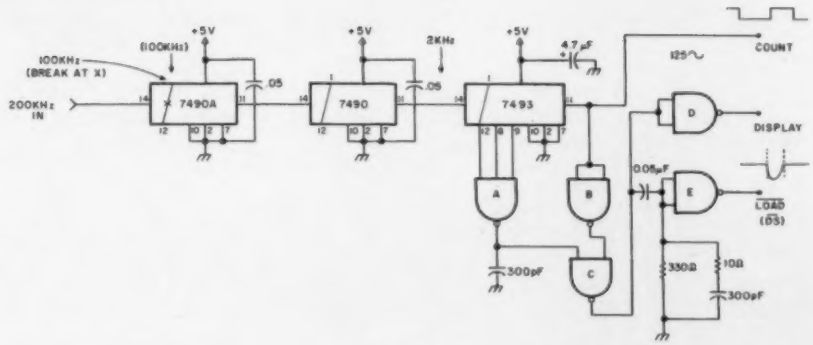

Fig. 4. Sequence generator. A – 1/3 7410; B and C – ¼ 74S00; D and E – 1/3 7410 or ¼ 74S00. One section of 74S00 is used in the input. This is the only place high speed is required. B should be at least as fast as A.

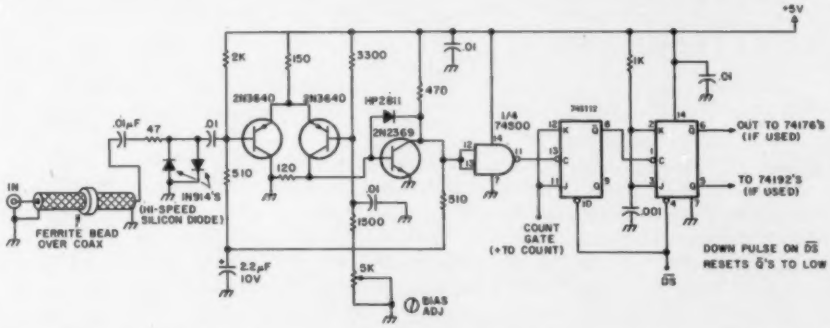

Fig. 5. Input amplifier and ÷4. Count sensitivity: 5 MHz – 2 mV rms to 1 V; 50 MHz – 25 to 40 mV; 70 MHz – 90 to 200 mV. Pins for 74S112: J – 3, 11; K – 2, 12; Q – 5, 9; $\overline{Q}$ – 6, 7; preset – 4, 10; +5 – 16; ground – 8.

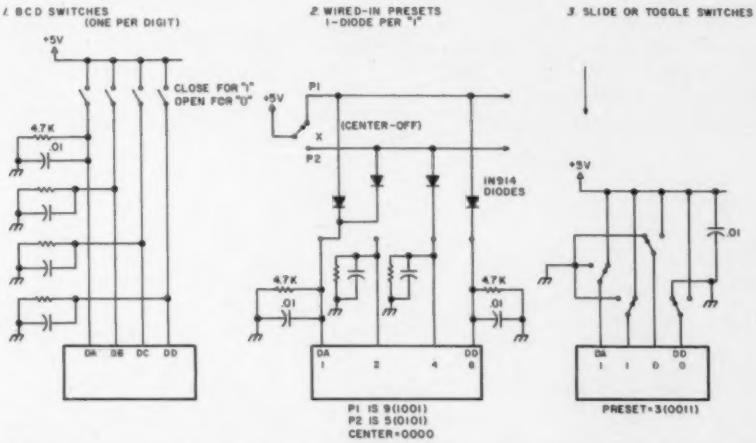

Fig. 6. Preset circuits. Receiver i-f = 454 kHz. Oscillator high – preset to 100,000-454 = 99546. If the oscillator is on the low side on the 12-30 band, then preset is 00454. (That's why there are two "preset" frequencies.)

capacitors are also across the resistors. Thus the preset switch takes only about 15 mA, but the decades will not reset properly if the "preset" down pulse is longer than a few microseconds. If your receiver "tunes backwards" on some ranges, you will need 74192 up/down counters, but, if it's strictly single conversion or has a fixed first i-f, there is a money and power saving from using 74176/8280 up counters. (The 74196, which counts up to 50 MHz and uses more power, can be plugged into the same socket.)

The input string shown takes a tenth volt at the coax

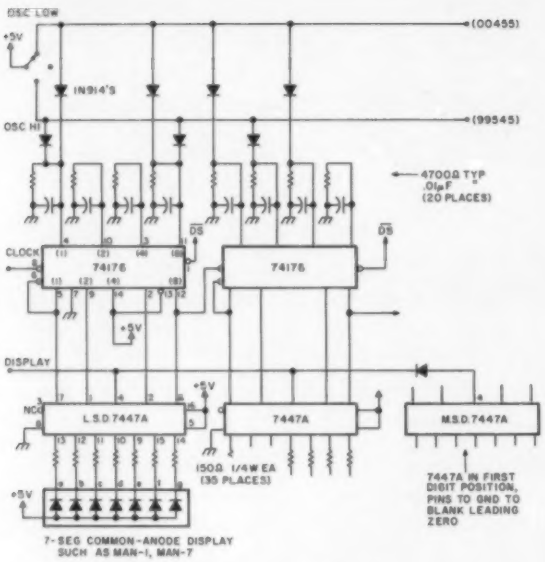

Fig. 7. Up-counter detail.

jack and will count up to about 70 MHz. Getting the signal into the coax should be solved at the receiver end. I use a transformer in the mixer drain lead and have used emitter followers, etc. The coax will only be a few feet long, anyway, so it may not be desirable to terminate it. All those amplifiers hold the signal down when it's strong and also reduce the gating hash that comes out the input (most commercial counters and scopes feed sync or gate pulses back into the circuit you're measuring) and thus into the receiver's signal path. Gating the J-K inputs to the 7S113 (a 74S112 is also okay) is the neatest way to turn a counter on and off, and it wasn't the only way I tried.

Almost any AT-cut crystal will be more stable than a 100 kHz unit and good enough for this. I used 2 MHz, but 1, 1.6, 3.2, 4, 5, or 10 MHz will do (James lists 2, 4, and 5 MHz, for instance). Input to the divider string is shown at 200 kHz, but, by unhooking the first flip-flop and going into pin 1 of the second 7490, 100 kHz can be used. The output of the third 7490 is at 2 kHz into a 7493, which provides the 4-millisecond count gate and drives the sequence gates for display and reset. Remember that the output of the 7493 must go up and down fast enough to gate the highest frequency to be counted. That's why the divider string doesn't have 74L90s or CMOS in it (74LS90s work fine, though).

There are 6 gates in the system if you don't have to switch the 74192s from up to down with a remote signal. At the input, a 74S00 drives the first flip-flop, a three-input gate is needed at the 7493, and a two-input gate is used. I used a 7410, but a 7420 (and the 74S00) would also do the job. Unused gates waste power; unused inputs can be strapped to used inputs with no problems.

The 74S113 is preset each time the decades are loaded, so that the number of counts in before the first pulse out is not a matter of chance (something I forgot the first try).

The three-input gate turns off about 0.1 microseconds before the output of the 7493 changes, so I put the 300 pF capacitor on it to make the waveforms come out right, though it isn't critical to the way things work.

The input amplifier transistors should be very fast digital types. The NPN can be a 2N2368, 2N2369, or 2N3011. If you can't get a Schottky diode (shown as HP2811), don't use a diode there. The PNP pair could be 2N4403s, although 2N3640s/MPS3640s are better. The bias adjustment is set up for best sensitivity at the high end of the receiver's range. I used a signal generator. The 2.2 uF capacitor is important. The transistors in the crystal oscillator can be the same types or 2N3904s and 2N3906s.

To keep the hash at a minimum and inside the box, be sure each IC has a bypass cap across its terminals (0.01 uF or larger) from plus 5 volts to ground so that the gulp of current that it takes when switching comes from a nearby source. Little dipped tantalum caps work okay here. Filter the ac line where it comes into the box, make the power supply and regulator somewhat separate from the rest, and slip ferrite beads on any wires between boards.

I used the power supply I described in *73 Magazine*, February, 1977, p. 41.

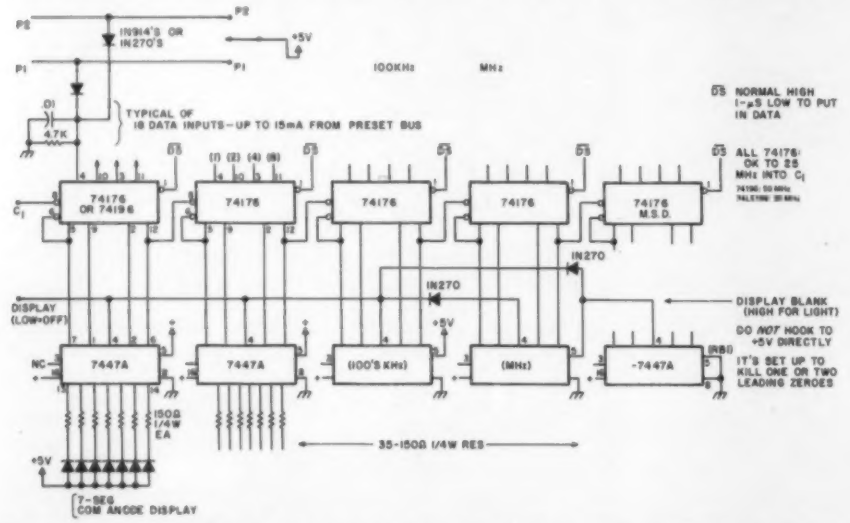

Fig. 8. Preset counter for digital dial (up-count only). 74176s use half as much power as 74192s, count on falling edge. Presets — 00455, 99545, 00915, 99085, 02215, 97785, etc.

Adding Varactor Fine Tuning

If you have a digital receiver frequency readout, adding fine electrical bandspread or incremental tuning becomes more attractive because the readout tells you the actual frequency without the need for adding the readings of two dials. Even some ham-band-only receivers could use a little more vernier action than they have.

To do a neat job of adding a fine tuning dial, I used a ten-turn helipot and a variable capacitance tuning diode. The voltage I had was plus 12.6, so the tuning bias was about 2 to 12. Because the range I wanted was about 25 kHz, the thermal drift of the diode was large enough to

matter at low tuning voltage. The emitter follower is included mostly so that its emitter-base temperature coefficient will buck that of the diode. For better linearity, a series capacitor (value about the same as the diode capacitance at 4 V bias) was used. The middle six turns of the pot give pretty uniform tuning, but things speed up at the ends. Note that there is a load resistor on the pot arm which also affects linearity at the high-voltage end.

The pot and knob (with a digital dial, no turns-counting dial is needed on the pot) can be put in the receiver if the panel has the room and you don't mind drilled holes, but it also can be stuck on outboard (shield it to keep the hum pickup down), with the wires snaked in via a ventilation slot.

When that worked, I got carried away and added a search function (i.e., the receiver sweeps back and forth about 25 kHz looking for DX when the band is quiet — it beats tuning by hand). It took an LM301 (I assume a 741 would also work, though maybe not as well), a switch, and the parts shown. For a slower sweep, use a bigger cap. Mylar is suggested, but I had some W5R ceramics. If you don't know why W5R and not Z5U, use paper or mylar and be sure.

If I were doing this to a tube receiver, I would buy or otherwise acquire a 40-volt rated varactor and a 36-volt zener to drop the B plus down to something more stable. The transistor specified will take more voltage, but the IC won't. It will (they say) run on 36 volts or less, as shown. ■

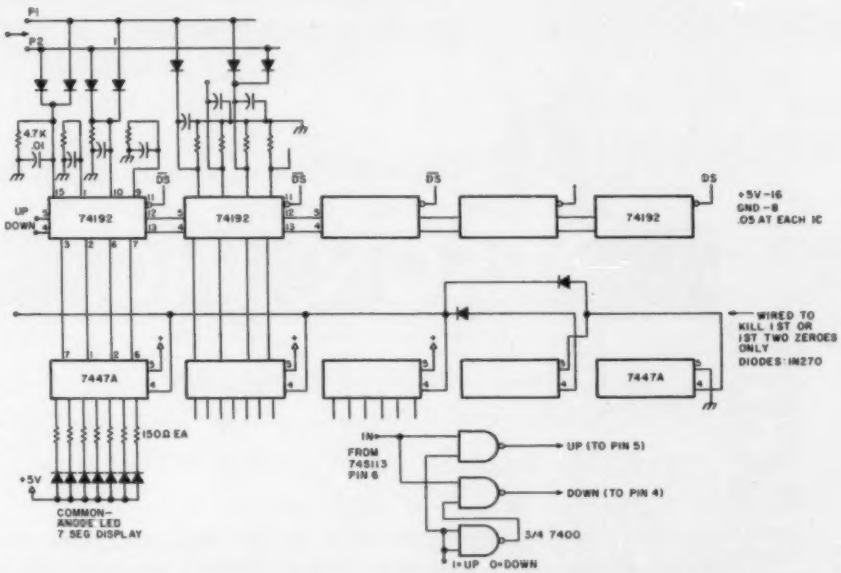

Fig. 9. Up/down counter for digital dial. P1 and P2 draw up to 15 mA. Data inputs to be 20 4.7k resistors and 20 .01 (or larger) capacitors. If up and down functions need to be switched, use a 7400 and take its input from pin 6 of 74S112. If gating isn't used, drive pin 5 or 4 from pin 5 of 74S112 and hook the other one to +5 through 1000 Ohms (don't leave it open).

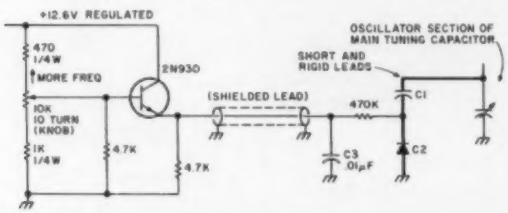

Fig. 10. Fine tuning. C2 — Motorola MV2103 (10 pF at 4 V, 30 V breakdown). C1 — 10 pF silver mica.

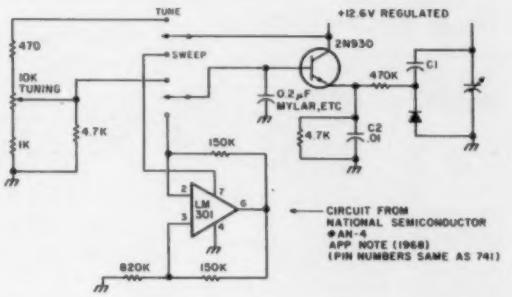

Fig. 11. Parts from James.

LETTERS

from page 65

program.

Marvin L. De Jong KØEI
Point Lookout MO

AID

Just a few words to let you know that your General class code tape and the *General Class Study Guide* proved to be invaluable in helping me to upgrade to General on my first try. The study guide gave me the necessary tools to objectively and intelligently answer all the FCC questions. Although I was not able to copy your 13+ code tape 100%, it nevertheless proved to be an extremely valuable aid.

Needless to say, when I get ready for the Advanced test, I will again use *73*'s study materials. Thank you for these very excellent aids at such modest cost.

Edwin R. Lappi WD4LOO
Carrboro NC

M2WRA

I am writing to inform the readers of *73* about the Mass 2-Way Radio Association (M2WRA), a non-profit organization whose purpose is to encourage those interested in all modes of 2-way radio to work together to raise funds for charitable purposes. We tried this with our 1977 Heart Fund Hamboree, a combination Hamfest and CB Jamboree, but were certainly far less successful than we planned: instead of making money for the American Heart Association, we lost over $2,000.00 and are still working to eliminate the balance of the debt.

At the present time, we are

Continued on page 73

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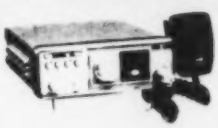

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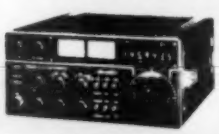

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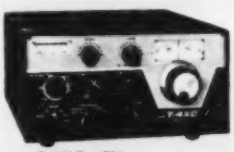

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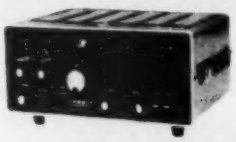

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Karl T. Thurber, Jr. W8FX/4
233 Newcastle Lane
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The FM Rebroadcaster

—*flexibility for the FRG-7*

I have acquired a Yaesu FRG-7 synthesized 500 kHz to 30 MHz general-coverage receiver. It fulfills a real need for a good continuous-coverage portable communications monitor and SWL receiver for my shack, supplementing the ham-bands-only coverage of the Tempo 2020 in use at W8FX/4. A dual-purpose accessory that would rebroadcast on the commercial FM band (88-108 MHz) what was received on the FRG-7 (affectionately known as the "Frog-seven"), combined with a code practice oscillator to keep up the code speed on long Air Force TDY (temporary duty) trips, became a highly desirable addition to my station.

I used a small 1" x 1" PC board FM wireless mike kit, available from Ramsey Electronics (P.O. Box 4072, Rochester NY 14610) for $2.95, which, along with a Cordover Model CWM-1 code module obtained from Burstein-Applebee Co. (3199 Mercier St., Kansas City MO 64111), meets this dual requirement.

The FM unit sold by Ramsey runs a mighty 100 mW output, can easily be tuned anywhere in the FM band, and will work off 3 to 9 volts dc. As the code module is designed for low-voltage operation, an old 6 V battery eliminator was scrounged from the junk box. When plugged into the rear of the unit through a miniature phone jack, it provides a convenient source of power for operating both the wireless mike and the CW module. A 3000 uF 16-volt electrolytic across the B+ line provides a high degree of hum suppression often lacking in run-of-the-mill transistor radio battery eliminators. A 9-volt-type 2U6 battery can be used as a power source, increasing the value of the series dropping resistor to the CW module, though battery life would be somewhat limited. A 6 to 9 V dc tap-off could be taken from the FRG-7 power supply, but I decided that going into the receiver was undesirable as it would be necessary to drill into the back panel to bring out the B+ wiring to the "Frog" box.

No particular construction precautions need be observed. I mounted a small 1½", 8-Ohm speaker in the bottom of the 3-¼" x 2-3/16" x 4" Radio Shack #250-251 equipment cabinet and epoxied the CW module (a solid-encased unit) to the magnet frame of the speaker. The FM PC board can be mounted to a piece of copper bus bar wire and squeezed into any convenient place in the cabinet. A front-panel mini toggle switch is used as a power ON-OFF switch, and another mini toggle serves to switch between the code practice oscillator and rebroadcaster functions. The rear panel houses a BNC antenna jack, miniature phone jack for dc power input from the 6 V dc battery eliminator (a J. C. Penny model 681-6542 swiped off an old portable which had long since given up the ghost), an audio-level adjust control for the FM unit, and a miniature Amphenol-type mike jack for audio input from the "Frog." The unit works particularly well with this receiver, as the Ramsey unit is designed for medium-to-high impedance input, and the FRG-7 has a medium impedance fixed-level audio output available on the front panel of the receiver. This fixed output is, of course, independent of receiver audio gain settings and therefore does not interfere with regular speaker or headphone operation. The FRG-7 tape output is, however, taken off prior to the audio filtering network, so that switchable audio selectivity is not available to the output feeding the FM rebroadcaster. The audio has also been fed

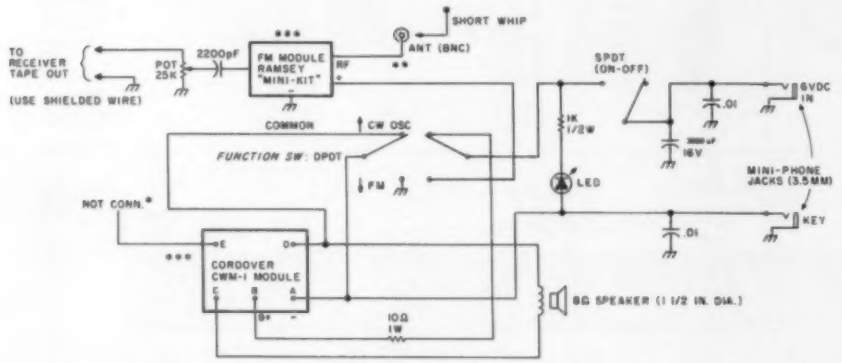

*Fig. 1. FRG-7 "Frog" box. *Used for rf pickup if the unit is to be used as an on-the-air rf-actuated monitor (not used in this project). **If connecting a short whip causes the unit to "pull" frequency excessively or to stop oscillating, insert a small-value capacitor in series with the antenna lead, or make a "gizmo" coupling on a few turns of insulated hookup wire and inductively couple. ***Refer to manufacturer's instructions for proper PC board/module connections.*

through an Autek QF-1 filter to the rebroadcaster with excellent results.

The CW module (obtained from Burstein-Applebee but also available from Poly Paks and others) is actually both a code practice oscillator and rf-actuated CW monitor, but I have not been able to obtain reliable results when trying to use the unit as a true on-the-air monitor. On-the-air CW monitoring is best obtained by use of a keyer relay, having the key actuate a relay which keys both the transmitter and the FRG-7 box simultaneously.

While others may have better luck in getting the rf function of the CW module to work, I've found from experience that getting dependable results from direct rf-actuated keying monitors is very difficult — performance usually varies considerably from band to band and depends also on such factors as power input, antenna loading, swr, and amount of rf floating around the shack. It's best to go to indirect monitoring for consistent results. The use of the FM unit is fairly straightforward. Once a short (10" to 20") antenna is fabricated from a length of bus bar or an old walkie-talkie whip and a BNC connector, the unit is adjusted simply by tuning a nearby FM receiver to a clear spot anywhere in the 88 to 108 MHz region and adjusting coil L1 of the FM unit (Fig. 1) until a strong, clear signal is received on the FM receiver. Of course, the frequency should be selected so as to not interfere with local FM stations (no need to induce further BCI problems). One should note that the antenna affects the transmitter output frequency, and, therefore, close movement next to it should be avoided. The little unit should easily transmit up to 300' or more, depending on location and length of the antenna hooked to the BNC output. It has been used for various purposes at W8FX/4, both in conjunction with a pair of lightweight FM cordless radio earphones and for general receiver monitoring while puttering around the house and yard. The tone of the CW module is dependent on the voltage applied; it is designed to operate with a nominal 1 to 1½ V dc power source (penlite cell), but will work well and produce a considerably louder and cleaner sound with a slightly higher voltage applied. The value of the dropping resistor in the 6-volt dc line (Fig. 1) will determine both the level of audio output and tone of the oscillator. Under no circumstances should more than 4 or 5 volts be applied to the module, as damage may result. A miniature phone jack installed on the rear panel provides a convenient key jack for code practice use, and a front-panel-mounted LED is wired so as to flash with CW keying when the unit is used as a code oscillator and to glow steadily when the unit is used in the FM rebroadcast mode, indicating that the unit is radiating.

Be sure that the dc adapter scrounged to power the unit isn't one of the cheapies with one lead of the dc output connected to one side of the ac line. Use of such a unit would present hum and grounding-out problems, not to mention the shock hazard involved.

I have found the FRG-7 "Frog" box to be a very handy device, and, of course, it can be used with other receivers not having a tape output by either connecting to the high side of the receiver's volume control (the preferred way), or by simply bridging across the low impedance headphone or speaker output of the receiver (at the risk of distortion due to impedance mismatching and/or overdriving). Also, although I didn't do it, the unit can be wired so that both the FM rebroadcaster and CW module are activated at the same time with audio from the CW module output also routed to the audio input of the rebroadcaster for group code practice sessions through individual portable FM receivers.

One further cost-effective tip for those who may construct the "Frog" box: If you intend to use it with a set of FM headphones for cord-free work, get a high-quality unit (such as one made by Archer or Panasonic) and install a mini phone jack on the headset so that it can also be fed audio directly from the receiver for use as an ordinary pair of headphones, eliminating the need for another set of headphones around the shack.

For an extra bit of class, use gray and black Dymo™ Label Maker strips for both front and rear panel labeling. As can be seen in the photo, both ¼" and 3/8" size strips are used for nomenclature. ■

LETTERS

from page 69

organizing a road rally and possibly another small event in August, and we are publishing a rapidly expanding newsletter. As newsletter editor, I am trying to recruit new members and subscribers.

Although our group is not yet in the same ranks as the ARRL, and our newsletter has a *few* more issues to go before we can compete with *73*, our newsletter does offer many features not found in other publications.

The newsletter, published monthly, offers several pages of coming events listings, in addition to a list of many 2-way radio clubs' regular meeting dates, and general information about various happenings in the two-way radio world. We are very much interested in knowing about other groups' meeting dates and events, including hamfests, flea markets, auctions, or field days.

At the present time, we have more CB members than hams, but we do not feel that it is fair to categorize the association as strictly a CB or ham group—we are neither. We are certainly in need of members of all kinds, and certainly could not complain if we had more ham members to help out on the many technical aspects of radio, and in fund-raising events.

The present membership rates are $10.00 (1st year only) and $7.00 renewal, and additional members at the same house $7 plus $4 per year renewal. Newsletter subscription only is $4 per year (single copy 35¢ plus postage). Copies of our by-laws and constitution are included in the membership, or are available for $1.00.

Anyone with any information for the newsletter or the Mass 2-Way Radio Association is en-

Continued on page 75

J. B. Fields III WB7SZC
344 W. Court
Weiser ID 83672

J. B. Fields, Radioman

—now it's the Navy's turn

All of us who read *73* are united by a common interest — amateur radio, of course. I have not been a ham for long, but I have had much valuable and enjoyable experience in the Philippines as a volunteer operator (MARS). As soon as I get back to the states . . . well, we'll see!

Amateur radio is getting more sophisticated every day. High quality receivers, microcomputers, and heaven knows what next are all combining to expand the horizons — for those who have the bucks.

Money is the universal problem here, or, rather, a lack of it is. How do we alleviate this problem? Usually the answer is work, and this means time away from our favorite pastime — amateur radio.

What I propose, therefore, is a way to spend more time with our hobby and earn money at the same time. Well, the law prohibits us from doing that, but there is a second best answer — a career in communications.

If this sounds like I'm trying to recruit you, perhaps I am, but it isn't as if someone is paying me to. Let me point out the recent article about Merchant Marine radio officers, or "sparks,"* as a description of one fine example of a hobby-related occupation. Let me also inform you that the State of California has openings for telecommunications specialists (particularly those with experience in UHF), and other states likely have similar needs. All you have to do is contact your state employment agency. Most nonmilitary employers will require that you hold a Second Class FCC ticket, but after the amateur tests . . . well, we should all be fairly adept at passing the candyman's exams. Right?

Maybe you don't feel very confident about passing the Second Class exam, or perhaps that twenty plus code business shakes you up. What next? Just what I've been leading up to — submarines.

Notice, I did not say "the military" or even "the Navy," though one of these may be an answer and, perhaps, be the right one for you. I am talking about what I think is the best all-around answer for the amateur today: the job of a radioman aboard a submarine.

In this article you are not going to read any new performance data, any technical information, or even very much about submarine communications. If that is what you want to know, go see a Navy recruiter, sign up for subs, and, once you are doing the job, somebody may have the courtesy to explain to you what it is you're doing. The purpose of this article is to be entertaining and informative about how to pay for our hobby by doing something we like.

What is it you like most about your hobby? Do you like to have the latest in equipment? Do you enjoy troubleshooting and repairing electronic equipment? Or do you prefer operating the equipment or sitting on a net? Let me tell you about Hog Heaven.

Sign up in the Navy, but make sure you are guaranteed RM "A" school. Recruiters are pretty sharp cookies, and they may have other places they need people more. If you stick to your guns, the recruiter will take you sooner or later to fill a quota, even if he has to guarantee you RM school.

Next, you breeze through boot camp — you're good at copying a message the first time around, and, if you're on your toes, this skill will whisk you right through boot camp.

RM "A" school is just another formality, but make sure you volunteer for submarines when you fill out your dream sheet. Once you've volunteered, there will be all kinds of instructors in the school who served in submarines and who will help see to it that you get there.

Next is Morse code school. If you can already copy thirteen, you may have a bit of fun here — get in a huff with an instructor, and wind up by betting him that you will be copying thirteen within a week. Upon graduation, you will be copying 22 wpm without even thinking about it.

Now you're getting closer to the Second Class FCC ticket. There can be even more help with the technical side of it, if you play your cards right.

After code school, there's sub school. That's four weeks of elbow-bending exercises in New London, Connecticut, and, after that, your first boat. Ask them, beg them, or even twist their arms, but make sure you get to the Radioman Electricity and Electronics school to get heavy on theory!

So far there haven't been any surprise tests — a few weekly quizzes and whatnot, but nothing like the FCC exams. Everything you need to know is presented so that you understand it. All you have to do is remember.

Now you are ready for that Second Class exam. Take it. You only have two years left in the service, and it will open doors for you later in civilian life. In the meantime, you are going to see some interesting times in the submarine service.

My first boat was the *USS Barb* (SSN-596), a nuclear-powered, fast attack class boat, home ported in Pearl Harbor, Hawaii! I was excited to see my orders, for the *Barb* had only recently made headlines by rescuing the crew of a downed B-52 in the middle of a hurricane. Here is the story as I later learned it . . .

Barb, en route to the position of the downed aircraft, was traveling at a depth of 120 feet. The force of the storm suddenly became sufficient to actually suck the *Barb* right to the surface! Once on the surface, all hell broke loose. The towering waves and gale winds caused the *Barb* to take rolls of up to *60 degrees* from side to side. The first roll was to starboard and caught everyone by sur-

*"See the World and Get Paid!", Gerald J. Hargett, *73 Magazine*, November, 1976, December, 1976.

prise. All the men sleeping in bunks on the port side of our single passageway were thrown out of their racks and onto the deck. As the rudely awakened sleepers greeted the day with appropriate remarks and tried to stand up on the heaving deck, the boat suddenly rolled to port, throwing all the remaining sleepers in starboard bunks atop the first group. Quite a tangle it was!

Meanwhile, back in the galley, Freddy, our salty head cook, could be heard invoking all the spirits of heaven and earth in his frantic attempt to keep dinner on the stove. The crew could visualize the beans pouring into the mashed potatoes. As if this were not enough, the ship was nosed into the waves to reduce the rolling, but the scramble continued. As the bow climbed skyward in the face of a mountainous wave, Freddy's cherry pies and sizzling roasts smartly departed the oven on a voyage aft across the mess decks. But, living up to his reputation, Freddy got it all together for an excellent meal.

The bridge was manned. Only the stoutest could survive the waves that engulfed the boat. The job of lookout fell to Richard Spaulding, a giant of a man, who until now was satisfied looking after our nuclear propulsion system. He held on, as time and time again waves nearing a hundred feet high broke over the bridge and tried to tear him away. All we had to direct us now was the helmsman's ability to interpolate the swinging compass in an effort to stay on course. But luck was with us: Richard spotted the liferafts between two swells. He fired a lifeline to the aircrew, but they were too exhausted to grab it. So, to cap the whole event off, the chief torpedoman, TMCS Hentz, lashed a line around his own waist and swam through the seas to reach them. On the first attempt, they timed it correctly. Chief Hentz successfully negotiated the seas and managed to tie the line fast to the liferafts.

Of the entire aircrew, only one man was lost to the sea. The bombardier was perhaps the most exceptional of the crew. He had managed to tie himself into one of the liferafts and, amazingly, caught a few moments of sleep while the storm raged around him!

Needless to say, I was anxious to join these men when I saw my orders. I flew to Pearl Harbor to meet the *Barb*, but she was still at sea. So I spent a month working for Submarine Flotilla Five and vacationing on Waikiki Beach. Then, early one morning, I was roused out of the rack and told to pack my seabag and report to the airport for a flight to Guam to meet the *Barb*.

The next twelve months were filled with "submarine qualifications" – tracing pipes and wires, and learning everything about the boat. At the end of this period of study, I went through a series of exams with my shipmates, the ship's engineer, the executive officer (XO – second in command) and finally with the captain, who pinned on the coveted dolphins – happy day!

Now, three years since reporting to the *Barb*, I'm stationed aboard the *USS Grayback* (SS-574). The *Grayback* is an amphibious assult submarine, home ported in Subic Bay, Republic of the Philippines. The story is the same – good friends, good chow, good pay, and terrific liberty in foreign ports such as Pusan in Korea, Yokosuka in Japan, Hong Kong, Kelung and Kaosuing in the Republic of China, and Singapore.

Recently, the *Grayback* completed a trip around the Philippines, called the 1976 "Bayanihan" Cruise. Bayanihan is a Philippine word meaning "helping hand." Our mission was one of good will; we distributed school books and medical supplies in six Philippine cities we visited. With the help of the American and Philippine Special Warfare Teams (Seals and UDT), we blasted out two coral beds to help construct a new pier and deepen a shipping channel. During the Bayanihan Cruise we visited several unusual ports. Some of the people had never before seen Americans. We were greeted like great explorers and heroes in every port, with an ensemble of parties, dancing, and fun! Think it was all fun? During the trip we gave over twelve thousand people their first tour aboard a submarine. That was the hard part!

Submarine life entails a lot of hard work but yields a commensurate amount of pleasure. A side benefit of duty aboard submarines is the close relationship between the officers and the crew. The wardroom is as elite a group among officers as the crew is among other Navy enlisted men. The submariner gets to watch from a ringside seat some of our nation's dynamic leaders. I, for one, have developed a considerable appreciation for the job they do.

The submarine Navy is referred to as "The Silent Service." This is because we seldom talk about our jobs. Qualified members of the crew are trained to perform the jobs of any other crew member, with the exception of the radioman. The radioman's knowledge is shared, at times, with only the captain himself. If you are an outsider, you will be welcome as a guest aboard for a tour in port, but your questions will be met either with a pat answer that reveals nothing or, if you persist, silence. Communications spaces are strictly off limits, so, if you want to learn more, don't ask questions – join us, and be a member of an exclusive organization. ■

LETTERS

from page 73

couraged to contact us.

Mark J. Welch
***M2WRA Newsletter* Editor**
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Northborough MA 01532
(617)-366-1266

BREAKING 80

On page 98 of your February, 1978, issue of 73, you published a very good project article by Walt Patterson WB6LQE on conversion of a CB rig to 10 meters. I had a Publicom I on hand, unused, and decided to try out the conversion.

I am so inept, and such a rotten technician, that I really had no hope of success. My storage area is replete with unworkable ham magazine projects, mute testimony to such and other deficiencies best left unmentioned. Some of them have been costly failures.

So I went ahead with Walt's plan, ordering the required crystals, with high hopes. I might say that his directions were simple and crystal clear (no reference to the electronic crystals, because two came bad and had to be remanufactured, which Cal Crystal Lab cheerfully took care of at no further expense to me). If you play golf, you will remember how you start off 18 holes of cowpasture polo with the firm belief that you are going to break 80, only to drag up to the clubhouse with a score closer to 180! That parallels my experience on ham radio build-it-yourself projects.

This time, however, I broke 80! The little rig took off like a wild banshee, with 4 Watts output, after I realigned the receiver rf and mixer coils and the five transmitter coils. On my *first* 10 meter QRP CQ call, I

Continued on page 77

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Campbell Road
Las Cruces NM 88001

Counter Accuracy For Perfectionists

—*updating the K20AW counter updates*

With measurement getting more precise and with the occasional availability of crystal ovens and other stable oscillator devices for clocks, the gain of another digit of precision on a counter can be desirable. Such can be the case for the K2OAW counter in the series of articles which started in May, 1972, in *73 Magazine*. If you think you have a very stable clock in your counter, so all kinds of numbers displayed aren't just random digits to impress the unaware counter believer, try this. (Refer to Fig. 1.)

Further inspired by an article by W4CUG (March, 1974, *73 Magazine*), where 62 MHz was achieved on the "barefoot" (low frequency) input, I decided to do the same for direct measurement of 6 meters to the nearest cycle. The project started just for fun. With the substitution of a 74S04 (for IC1) at the output of the (new and improved) 5 V dc MPF102, an HEP S0020 input amplifier in place of the regular 7404, and then a 74S00 (for IC2) in the input selector circuit in place of the regular 7400, the stage was set for speed. The 7473 input divide-by-two gate was replaced with a 74H73. Measurements were made to almost 45 MHz. As a 74S73 could not be found at the time, a 74S112 similar type dual JK was inserted with minor rewiring (with the count enable and reset A all used just as before) – and, lo and behold, a marginal 65 MHz was counted. (See Fig. 2.)

Having done what W4CUG had reported before, my objective became: Just how fast will the thing go with simple modifications? I scrounged a couple of 74196 chips and installed them in the IC6 position, which is a divide-by-five (this is the least significant digit BCD coder). I found that these two 74196s running divide-by-fives were not as fast as a carefully selected 7490, which was there in the first place.

A 74S196 opened a whole new world, however. Incidentally, don't forget to change the reset line to the chip from B to A, or it won't even open a gate! When the thing was turned on, it promptly leaped to above 90 MHz, but slowly fell to 80 and then 70 MHz. Careful checking found the 74S04 (IC1) to be quite hot when, and only when, switching fast. Another 74S04 did the same thing. A 15 Ohm 1 Watt resistor was placed in the Vcc line to this chip, dropping the voltage to 4.1 to 4.2 (this value was carefully chosen by testing for maximum count). When turned on, the counter leaped to 107 MHz and settled to 100 to 101 MHz, with very stable count. Heat sinking the 74S04 with epoxy to a piece of 1/8-inch aluminum allowed a stable count to 105

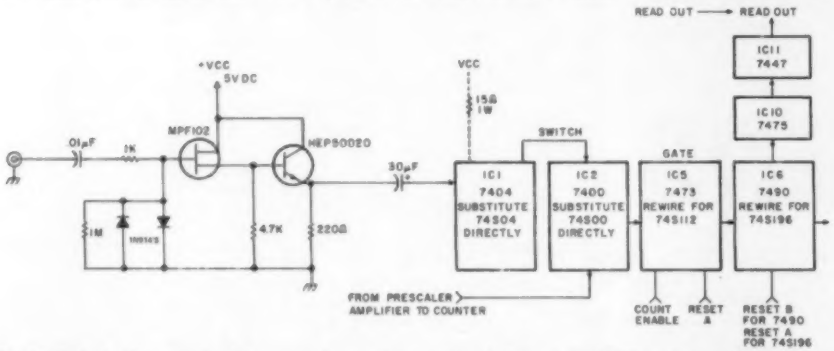

Fig. 1. This is the standard improved type input circuit. It uses an FET and a regular transistor with no odd voltages. The TTL interfacing is achieved with a 7404 type chip. This arrangement is very sensitive. The rest of the chips in this counter front end are shown as they relate to this article.

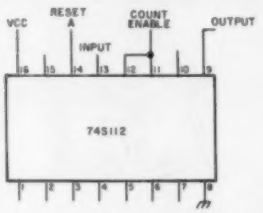

Fig. 2. This is how I wired in the 74S12 to replace the 7473 chip in the divide-by-two input gating circuit. There are two JK flip-flops in this chip – only one is used. This is an essential substitution for high speed counting.

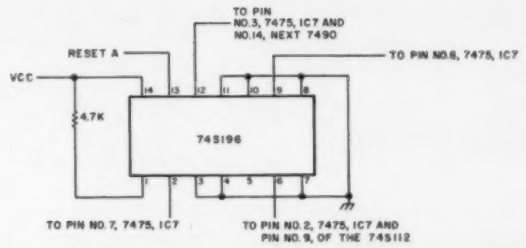
TO PIN NO.3, 7475, IC7 AND NO.14, NEXT 7490
RESET A
TO PIN NO.6, 7475, IC7
VCC
4.7K
74S196
TO PIN NO.7, 7475, IC7
TO PIN NO.2, 7475, IC7 AND PIN NO.9, OF THE 74S112

Fig. 3. This is how I hooked up a 74S196 to substitute in the IC6 position for the 7490. This is necessary to divide by five at a rate of better than 50 MHz. Note that the gating stage before (IC5) divides by two, which gives a total of divide by ten at the first readout, allowing counting to the nearest Hz.

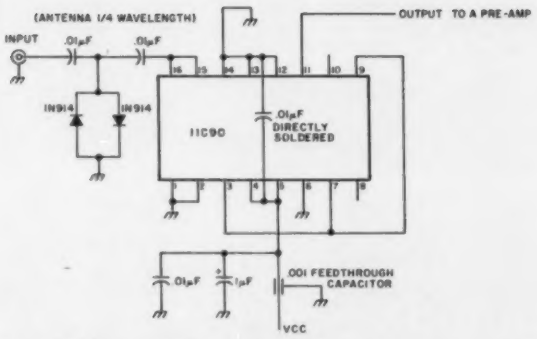

Fig. 4. This standard circuit will divide by ten to over 600 MHz (cheaply). With a second 5 V dc amplifier, as shown in the counter front end (Fig. 1), after *this chip, the counter will count a Wilson handie-talkie at over 20 feet! Note that there are no chokes, coils, input bias circuits, etc. Do not overload this chip with rf.*

MHz. (See Fig. 3.) This substitution of a 74S196 for the 7490 (least significant digit position) is for IC6 only.

There is some question as to whether 125 MHz can be reached or not. My counter was hand wired on 1/10 inch perfboard (which is just as fast as redoing some of the older available boards for all the new changes) and, at 105 MHz, some critical positioning of parts was noted. The 74S04 seems to be the weakest link in the chain, and a 74S00 in a different configuration was tried but fell just short of 100 MHz. A grid dip meter with inductive coupling was used for a high frequency signal source.

Why the speed? Simple. With an 11C90 chip (available at a nominal price of about $16.00), one can go to 600+ MHz and to the nearest 10 Hz! The 11C90 is internally biased, so there isn't the fooling around of the old 95H90 circuits that involves tuning them up. Don't forget that your clock needs 10^{-8} accuracy to claim that all those little lights mean more than a beer sign. (See Fig. 4.) Direct soldering of the 11C90 prescaler chip to a PC board is recommended. In and out should be short coax, and jump pins 4 and 5 to 12 and 13 with a .01 uF capacitor with very *short* leads. Surround everything with ground (gives good connection for 1, 2, 6, 12, 13, 14, to ground) on the PC board. I then enclosed the 11C90 in a metal box of soldered copper. Be very careful not to overload this chip with 150 MHz to 450 MHz rf. It can be destroyed as the input diode protection is poor at these frequencies.

The 11C90 was purchased from Tri-Tek, Inc.[1] The 74S00 for 30¢ ('76 catalog only), 74S04 for 35¢, 74S112 for 75¢, and 74S196 for $4.00 ('77 catalog only) were all purchased from James Electronics.[2] Delivery was under seven days from both places.

If one is critical in chip selection (some are noisy, switch slowly, work better at different voltages, etc.), good results will follow. A 74S73 substitute for the 7473 in the IC5 position was found *not* to work much faster (I may have run into some bad chips). Even a slow scope will tell a good chip from a bad one by examining activity on various pins. The low frequency counting is affected by all this to some extent. At 120 Hz and lower, the Vcc resistor on the 74S04 in IC1 position must be bypassed. It will then go to about 40 Hz, but is not exactly stable, i.e., is plus or minus 2-3 Hz. Substituting the old 7404 back in IC1 gives good stability to 50 Hz. Much slower counting than this you can do yourself!

If you're worried about messing up a PC board, don't be. Lead length is not critical (short of 6 inches to a foot), so the chips (74S196 and 74S112) can be "hung in the air" above the board and wired up easily with short leads. I have carefully checked each of these chip substitutions repeatedly to make sure my findings are not just a fluke. Anyone trying these four chip substitutions should have good results. So count 'em, but count 'em fast. Maybe someone will come up with a "barefoot" ECL counter that will reach two meters to the nearest cycle . . . someday — but simply and cheaply? We really need that last Hz anyway! ■

References

[1]Tri-Tek, Inc., 6522 N. 43rd Ave., Glendale AZ 85301.

[2]James Electronics, 1021 Howard Ave., San Carlos CA 94070.

LETTERS

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was answered by another ham in Grimsby, Ontario, who gave me a 5 x 8, then another station in Sharon, Pa., who gave me a 5 x 9 plus 20, followed by another 5 x 8 from Springfield, Ohio, and a 5 x 7 from Canton, Ohio. Astonishing and fun, to say the least. I think Walt WB6LQE should get much credit for letting us know. I can't help but wonder if he could come up with another simple fix to get this rig on SSB!

One caution: Keep in mind the warning to not try to monkey with the coils locked in with wax. I tried it with coil 301 and succeeded in destroying the core. I had to scrounge around for a substitute—my only difficulty. Thanks for a lot of fun. This afternoon, I found a couple of CB stations on this rig on ten meters, and they got off the air fast when I told them they were illegally on the ham band.

Mike Simpson W6CRD
Long Beach CA

PANTS DOWN?

From the April issue of *73*, page 6, under "The Yellow Peril," I quote: "The most basic truth of international trade is that if we want to sell our equipment in Japan, we have to let them sell theirs here." Later on you say, "And if you don't think they are buying American ham gear in Japan, you just haven't talked to many Japanese hams."

Well, Wayne, for once I've caught you with your pants down. You obviously haven't done your research, for you fail to mention that we tax imports into the States at better than 5% to 15%, and place no re-

Continued on page 79

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The New Op Amps

—*better, lower cost*

A new breed of operational amplifier has appeared which has advanced the state of the art significantly and again put former "mil spec" devices within the realm of common amateur application. Until now, common operational amplifiers (741, 709, etc.) have been fabricated using only bipolar technology. At least three manufacturers, Texas Instruments, RCA, and National Semiconductor, have now introduced operational amplifiers with both field effect and bipolar transistors fabricated on a single monolithic chip. (National's process uses JFETs, while RCA uses PMOS transistors.) This has resulted in a relatively inexpensive, moderately fast operational amplifier with super low bias currents and an almost immeasurably high input resistance.

First, a word about bias currents, offset voltage, and input impedance (this all assumes at least a passing familiarity with operational amplifiers to begin with, which you probably have or you wouldn't have read this far), and then a sketchy comparison of the industry standard, the 741, and the new BI-FET (National) and BIMOS (RCA) devices.

Basic operational amplifier theory assumes that the two operational amplifier inputs have an infinite resistance, i.e., no electrons flow into these terminals. In truth, all operational amplifiers (at least any that I've ever heard about) have some finite input resistance and some finite current, called bias current, into these input terminals. The average of these two currents, one into each input, is called "input bias current." Spec sheets normally list this input bias current as both a maximum allowable at 25° C. and as a max. over the full temperature range of the device, the latter current being higher by a factor of 3 or 4. The *difference* in the actual bias current into each input of the operational amplifier is termed the "input offset current." Again, the maximum input offset current is specified at both 25° C. and over the full guaranteed operating temperature range.

The current which sneaks into those input terminals obviously must come from somewhere. I have yet to find this current source discussed specifically, but the universal implication is that *any* source will do. Any dc-coupled source which is connected in any way to either input of the operational amplifier will act to contribute to this bias current. To illustrate, check Fig. 1(a), a voltage follower configuration. The bias current for the inverting input is supplied by the operational amplifier output; that for the noninverting input is supplied by the V_{in} source. Fig. 1(b) illustrates a differential amplifier with four bias cur-

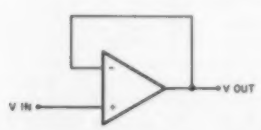

Fig. 1(a).

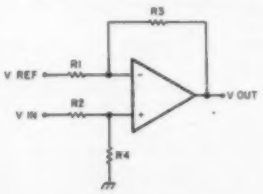

Fig. 1(b).

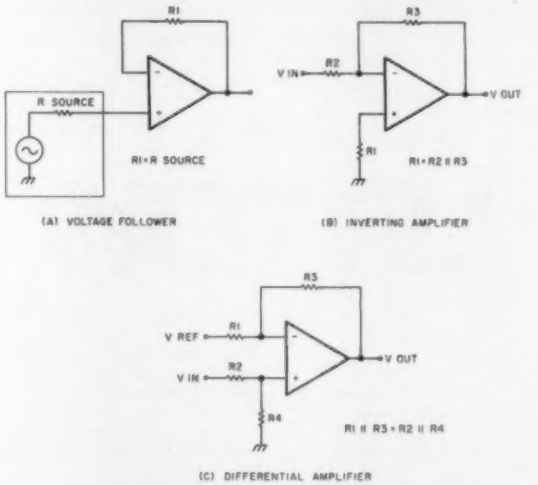

Fig. 2. Bias current compensation.

	741C[7]	CA3140[6]	LF356[7]	Units
Input offset voltage	6	5	10	mV
Input offset current	2×10^5	0.1	50	picoamps
Input bias current	5×10^5	2	200	picoamps
Input resistance	0.3	10^9	10^6	megohms
Slew Rate	0.5	7	12*	volts/us
Gain — bandwidth	1*	3.7	5*	MHz
Supply Current	2.8	1.6	10	mA

*Table 1. * = typical value; others are worst case.*

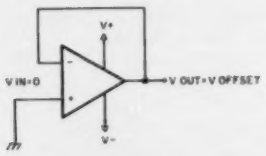

Fig. 3. Follower offset.

rent sources. The inverting input receives current from the operational amplifier output through R3, and from the V_{ref} supply through R1, while the noninverting input receives bias current from ground through R4 and from the V_{in} supply through R2. So much for the bias current sources. I should also point out that bias currents and input impedances are not directly related. The bias currents are drawn by constant current sources in the operational amplifier, and will be present no matter how large the external impedances which may be connected to the operational amplifier inputs. The input resistance is the resistance between the two input terminals of the operational amplifier. I don't pay much attention to this when designing operational amplifier circuits, since it only affects circuit gain if the external resistances used are much larger than this input resistance.[3] Even with a 741, keeping external resistors to 100k or less will allow you to neglect its influence.

To compensate for input bias currents, design in such a way as to present an equal resistance to each operational amplifier input terminal. Note the examples in Fig. 2.

By forcing the input bias currents into each input to pass through equivalent resistance values, equal voltage drops are produced at each input, and errors introduced will be minimal. Note that we cannot compensate for the input offset current, as we don't know which input terminal will have the larger current.

The third parameter of interest here is "offset voltage" or "input offset voltage," which is defined as that voltage which must be applied between the input terminals to obtain zero output voltage.[1] What this means to us is that with a circuit as shown in Fig. 3, a unity-gain voltage follower, connecting the input to ground will produce an output equal to the offset voltage.[2]

In most voltage follower applications (gain = 1), this offset voltage is probably negligible. The catch is this: The offset voltage *multiplied by the gain of the circuit* is the error voltage appearing at the output of the operational amplifier[4]; thus, a 741 operational amplifier with an offset voltage of 5 mV and a gain of 20 would exhibit an output 0.1 V (100 mV) different than that calculated for an assumed perfect operational amplifier. Fortunately, offset null terminals (and various circuit configurations[5]) are available to null out, or remove, the effects of input offset voltage.

Table 1 compares the 741, CA3140 (RCA), and LF356 (National). Texas Instruments also makes the LF356, with apparently the same specs. All data listed is valid at 25° C.; these devices are the commercial- or consumer-grade products. The LF356 is available as an LF356, LF356A, LF256, LF156, and LF156A, with ever-tightening specs. The CA3140 likewise ascends to CA3140A, and then CA3140B. Package style for the CA3140 is 8-lead TO-5 can only; a T-suffix specifies a common 8-lead can, but an S-suffix specifies leads which have been formed to match a mini-DIP socket. National's LF356N comes in a mini-DIP plastic package, while the LF356N is packaged in an 8-lead can. From the data in the table, the RCA device appears to be a bit slower than the LF356, but otherwise looks like a better choice. Two further points concerning selection: The minimum supply voltage (single-ended) for the CA3140 is 4 volts, but the LF356 is not recommended for operation at less than ± 5 V. The CA3140 is a steal at $1.10 (from Tri-Tek). The LF356N is available from National distributors at $3.75 in singles. Last comment: An RCA dope sheet is available free from RCA (see reference 6). National's linear data book (see reference 7) is available from Tri-Tek (as is RCA's dope sheet, for $0.60). ■

References

[1] Underwood, Robert K., *New Design Techniques for FET Operational Amplifiers*, National Semiconductor Application Note AN-63, March, 1972.

[2] RCA Corporation, "Integrated-Circuit Operational Amplifiers," published in RCA's 1975 databook, *Linear Integrated Circuits: Application Notes*, SSD-202C, page 191.

[3] Texas Instruments, Inc., *Linear and Interface Circuits Applications*, 1974, page 8.

[4] *Ibid.*, page 9.

[5] Dobkin, Robert C., *Universal Balancing Techniques*, National Semiconductor Linear Brief LB-9, August, 1969.

[6] RCA Corporation, file number 957, April, 1976.

[7] National Semiconductor, *Linear Data Book*, 1976.

LETTERS

from page 77

strictions when such goods offer heavy competition to American-made products. But what I believe is unknown to you is that the Japanese tax American goods 45% to 55%. And when goods that even with this stiff tax on them threaten domestic production, they are promptly banned from Japan.

A fine example of this is the new Atlas 210X which I recently purchased. The stateside price for my radio, from a local dealer, was $850. The same radio in Japan was a little over $1300. And this is wholesale in both countries.

Another example is the ban on American leather products that, even with the tax, offered competition to the domestic leather production. Thus, a quick ban was enacted.

Oh sure, in time, things will balance out as you have pointed out. But, in the meantime, what about the value of the American dollar and the Americans out of work because of all the imports that almost kill American production?

But the biggest thing that bothers me is the unfairness of the entire thing. I'm all for international trade as long as it's done in a fair matter. But the one-sided trade agreements that are now practiced are certainly not fair to American producers.

Personally, I'm for higher import taxes until the offending nations lower their import taxes to allow American-made goods to compete fairly. If they don't, that's alright, too, for American businesses will grow and prosper. And to do my part, from now on I'm buying American-made goods!

George Cochran
Cherry Point NC

Continued on page 85

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Montgomery AL 36117

22 Remote

—outside programming for your IC-22S

The Icom 22S has proved to be one of the most versatile FM transceivers around today and is, indeed, becoming even more so by virtue of being the subject of many customizing modifications, particularly with respect to its substantial programming capabilities.

A previous article in *73 Magazine* ("The New 88 Channel IC-22," Jan., 1977) describes a unique means of extending the programming capabilities of the 22S using only two toggle switches. Not wanting to reprogram the board (a tedious, tricky job) and not wishing to drill into the case to mount the two switches, I decided to leave the board programmed for the 22 most popular repeater and simplex frequency channels likely to be encountered. I would use the unused 23rd channel strip on the matrix board for an outboard programmer, building eight individual diode selector switches into a remote box.

In the IC-22S, channels are selected by switching in one of 22 (or 23, if you count the unused channel strip) preprogrammed diode matrices. The diodes are normally soldered into position on each channel strip according to a chart furnished by the manufacturer. Depending on the base frequency desired, from one to eight diodes can be cut into the synthesizer circuit, as shown in the matrix arrangement of Fig. 1.

To remotely program the IC-22S, the programmer described in this article can be built with very little effort or special technique. How-

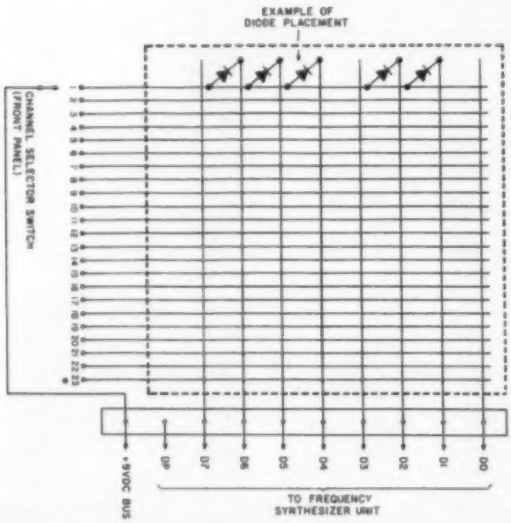

*Fig. 1. Diode matrix arrangement. *Connection added from channel selector switch to matrix board.*

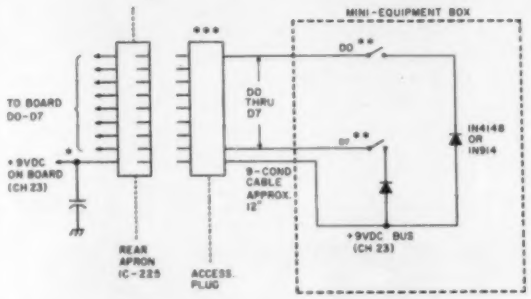

*Fig. 2. Remote programmer circuit. *Each pin bypassed to ground with .01 uF disc ceramic capacitor. **Only D0 and D7 switches and diodes are shown. D1 through D6 are wired in the same manner using the +9 V dc bus from channel 23 line on board as common. Total of eight SPST toggle switches required. ***Changing to a 24-pin connector set (plug and socket) would allow enough connections for a zero-center discriminator meter and TT pad, in a somewhat larger minibox. The meter would use connections already brought to the rear apron: TT audio across mike input and TT dc from any convenient point.*

ever, running the internal wiring must be done with extreme care because of the compactness of the unit and the delicacy of the matrix PC board. (I am speaking from experience, having carelessly damaged the board in the initial programming process.)

To set up the Icom for remote programming, first run a wire from the unused 23rd position on the rotary channel selector switch carrying the +9 V dc bus to the channel 23 line on the matrix board. This position, though unnumbered on the dial selector switch, appears as the first dot past channel 22. Making this connection energizes the 23rd-channel matrix bank. Then, using 9-conductor cable (unshielded is okay), run wiring from D0, through D7 and the +9 V dc bus, to the nine-pin connector on the rear apron. (The present wiring to the connector, a ground lead on pin 8 and a discriminator takeoff on pin 1, should be disconnected.) Each pin should be bypassed to ground using a nominal .01 uF disc ceramic capacitor.

A 12" length of 9-conductor cable can be connected to the 9-pin accessory plug supplied with the unit and run to a small equipment cabinet (Radio Shack #270-251 or equivalent). There, a bank of eight 1N4148 or 1N914 diodes can be switched in or out of the circuit using eight SPST mini toggle switches, as shown in Fig. 2. (If SPDT toggles are available, the unused position provides a convenient mounting post for one end of the diode.) Although the diodes could be mounted to the board, you'll probably have fewer problems mounting them in the box on the switches.

I take the remote programmer along in my mobile installation only when traveling to an area which has a repeater combination pair or oddball simplex channel not already programmed into one of the regular 22

*Fig. 3. Remote programming. Frequency versus diode placement. *Switch position numbers are keyed to numbers shown in the programmer photograph.*

SWITCH POSITION*↑		8	7	6	5	4	3	2	1
Frequency	Total 'N'	D7	D6	D5	D4	D3	D2	D1	D0
146.010	108		x	x		x	x		
146.025	109		x	x		x	x		x
146.040	110		x	x		x	x	x	
146.055	111		x	x		x	x	x	x
146.070	112		x	x	x				
146.085	113		x	x	x				x
146.100	114		x	x	x			x	
146.115	115		x	x	x			x	x
146.130	116		x	x	x		x		
146.145	117		x	x	x		x		x
146.160	118		x	x	x		x	x	
146.175	119		x	x	x		x	x	x
146.190	120		x	x	x	x			
146.203	121		x	x	x	x			x
146.220	122		x	x	x	x		x	
146.235	123		x	x	x	x		x	x
146.250	124		x	x	x	x	x		
146.265	125		x	x	x	x	x		x
146.280	126		x	x	x	x	x	x	
146.295	127		x	x	x	x	x	x	x
146.310	128	x							
146.325	129	x							x
146.340	130	x						x	
146.355	131	x						x	x
146.370	132	x					x		
146.380	133	x					x		x
146.400	134	x					x	x	
146.415	135	x					x	x	x
146.430	136	x				x			
146.445	137	x				x			x
146.460	138	x				x		x	
146.475	139	x				x		x	x
146.490	140	x				x	x		
146.505	141	x				x	x		x
146.520	142	x				x	x	x	
146.535	143	x				x	x	x	x
146.550	144	x			x				
146.565	145	x			x				x
146.580	146	x			x			x	
146.595	147	x			x			x	x
146.610	148	x			x		x		
146.625	149	x			x		x		x
146.640	150	x			x		x	x	
146.655	151	x			x		x	x	x
146.670	152	x			x	x			
146.685	153	x			x	x			x
146.700	154	x			x	x		x	
146.715	155	x			x	x		x	x
146.730	156	x			x	x	x		
146.745	157	x			x	x	x		x
146.760	158	x			x	x	x	x	
146.775	159	x			x	x	x	x	x
146.790	160	x		x					
146.805	161	x		x					x
146.820	162	x		x				x	
146.835	163	x		x				x	x
146.850	164	x		x			x		
146.865	165	x		x			x		x
146.880	166	x		x			x	x	
146.895	167	x		x			x	x	x
146.910	168	x		x		x			
146.925	169	x		x		x			x
146.940	170	x		x		x		x	
146.955	171	x		x		x		x	x
146.970	172	x		x		x	x		
146.985	173	x		x		x	x		x
147.000	174	x		x		x	x	x	
147.015	175	x		x		x	x	x	x
147.030	176	x		x	x				
147.045	177	x		x	x				x
147.060	178	x		x	x			x	

Continued.

147.105	181	x		x	x		x		x
147.120	182	x		x	x		x	x	
147.135	183	x		x	x		x	x	x
147.150	184	x		x	x	x			
147.165	185	x		x	x	x			x
147.180	186	x		x	x	x		x	
147.195	187	x		x	x	x		x	x
147.210	188	x		x	x	x	x		
147.225	189	x		x	x	x	x		x
147.240	190	x		x	x	x	x	x	
147.255	191	x		x	x	x	x	x	x
147.270	192	x	x						
147.285	193	x	x						x
147.300	194	x	x					x	
147.315	195	x	x					x	x
147.330	196	x	x				x		
147.345	197	x	x				x		x
147.360	198	x	x				x	x	
147.375	199	x	x				x	x	x
147.390	200	x	x			x			
147.405	201	x	x			x			x
147.420	202	x	x			x		x	
147.435	203	x	x			x		x	x
147.450	204	x	x			x	x		
147.465	205	x	x			x	x		x
147.480	206	x	x			x	x	x	
147.495	207	x	x			x	x	x	x
147.510	208	x	x		x				
147.525	209	x	x		x				x
147.540	210	x	x		x			x	
147.555	211	x	x		x			x	x
147.570	212	x	x		x		x		
147.585	213	x	x		x		x		x
147.600	214	x	x		x		x	x	
147.615	215	x	x		x		x	x	x
147.630	216	x	x		x	x			
147.645	217	x	x		x	x			x
147.660	218	x	x		x	x		x	
147.675	219	x	x		x	x		x	x
147.690	220	x	x		x	x	x		
147.705	221	x	x		x	x	x		x
147.720	222	x	x		x	x	x	x	
147.735	223	x	x		x	x	x	x	x
147.750	224	x	x	x					
147.765	225	x	x	x					x
147.780	226	x	x	x				x	
147.795	227	x	x	x				x	x
147.810	228	x	x	x			x		
147.825	229	x	x	x			x		x
147.840	230	x	x	x			x	x	
147.855	231	x	x	x			x	x	x
147.870	232	x	x	x		x			
147.885	233	x	x	x		x			x
147.900	234	x	x	x		x		x	
147.915	235	x	x	x		x		x	x
147.930	236	x	x	x		x	x		
147.945	237	x	x	x		x	x		x
147.960	238	x	x	x		x	x	x	
147.975	239	x	x	x		x	x	x	x
147.990	240	x	x	x	x				

to be switched on (diode in) for each desired base frequency. Any 15 or 30 kHz channel can be programmed from 146 to 148 MHz. Actually, frequencies well into the 145 MHz region can be programmed if time is taken to do the binary calculations required. Of course, only standard 600 kHz channel spacing is possible without further modification of the unit's innards. The duplex/simplex switch is normal with the remote programmer selecting the base frequency, as in the case of internal channelizing.

The remote programmer adds considerable flexibility to an already exceptionally versatile two meter transceiver and is well worth the small added cost — and it requires no defacing of the cabinet. At trade-in time (1999?), the 22S can easily be restored to its original configuration.

Another variation of the "no irreversible mods" policy that I adhere to, to protect the unit's trade-in value, involves obtaining an extra matrix board from Icom (for $3), a few dozen extra 1N4148/1N914 diodes, and a rotary selector switch (23-channel CB type?). The auxiliary board can be permanently programmed for an additional 22 or 23 channels, mounted in a mini equipment cabinet, and wired into the channel 23 unused switch position, as indicated previously. A near ultimate low-cost programmer would combine both the auxiliary board and the eight selector switches into a single programmer box (slightly larger, such as Radio Shack #270-252 or equivalent) for 44-channel preprogrammed capability, plus the added flexibility of all-channel programming when required. Such a combination would be particularly useful in the northeast or in southern California, where there are more repeater channels in use than most rigs can conveniently handle. ■

channels. A few strong magnets are epoxied to the bottom of the mini equipment cabinet (in lieu of the rubber mounting feet) to allow the unit to be firmly attached to the Icom when mobiling. For convenience, the manufacturer's "D0" through "D7" matrix board designations are relabeled simply 1 through 8 and marked as such on the box, as indicated in Fig. 3. A small 3" x 5" card is made up showing which switches are

IC-215 FM PORTABLE/MOBILE

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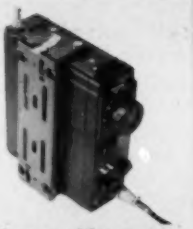

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Handling Ole George

— *is amateur radio ready?*

The newspaper classified ad was explicit . . .

For sale: Ham radio Novice station – transmitter, receiver, PS . . . $150.00.

End of ad.

The equipment consisted of an AF-68 transmitter, a PMR-8 receiver with matching power supply, and all manuals. The Dow Key relay and speaker were not included, but, for a cash deal to a really sincere amateur enthusiast, they would be included for the original asking price.

The calls I received were numerous. Ten percent were from knowledgable amateurs trying to make a deal for the power supply and receiver. A number were from people who wanted the transmitter. Several callers wanted to know the output and whether or not the transmitter would work on the CB band.

And then "Ole George" called. George didn't know what he wanted. George is not a kid. He is a forty-nine-year-old grandfather who teaches for a living. He has operated illegally on the CB band for the past two years, or, I should say, operated *out of* the CB band, with a few more Watts than the legal power limits on SSB.

It was a short introductory conversation over the phone, a brief description of the coverage of the units and their condition, followed by an invitation to come and look at the merchandise. The invitation was accepted. Ole George proved to be a perfect example of many who are attempting to make the transition to amateur radio from the ranks of the great unknowing. He had never talked to an amateur, did not know one, and had never opened a book to learn what ham radio was all about. I gave him a brief rundown of a general nature on what a Novice needs to know – easy (?) ways to learn code, the five-word Novice requirement, information needed to pass a Novice test – and I answered his questions:

"What bands are open to a Novice?

"What number is that on the dial?

"What can I use for an antenna?

"Can I use the same antenna that I use on CB?

"Can I throw away my CB license after I get my amateur license and still operate CB legally?"

And on and on and on . . .

At the end of our three-hour discussion, I had successfully sold an excellent Novice and standby rig to someone I thought might someday wind up as a good working amateur.

One question kept popping up during our discussion:

"Would the expensive Citizens Band antenna that is positioned over my (George's) house work with the AF-68 transmitter?"

I told him that, with a few slight modifications, it would work on a ham band of higher frequency.

George's overwhelming desire to learn about amateur radio was inspiring, except for the constant referrals to the operation of the units he was about to buy.

"Could they be operated on CB or ten meters? How?"

These questions were interspersed with:

"I have been studying the code for some time now. I'll pay you to teach me on a regular basis. I'll do anything you ask; just help me get a Novice license."

Now, my technical ability is limited to the extent that I have a tough time maintaining my own personal equipment, but I am also of the belief that a Novice doesn't have to be a wizard in electronics to get a license. However, the applicant should have the ability and desire to learn the technical side of amateur radio after he gets his Novice license. That's where the largest number of newcomers are discouraged. It's difficult to find classes designed to teach the Novice how to increase his technical skills.

George's apparent sincerity to become an amateur led me to the kitchen table and a pad and pencil. This would be my first attempt at setting up a simple lesson or routine to follow in order to obtain a Novice license. I even found the old schematic of a one-tube (6L6) crystal-controlled 40 meter transmitter that I had built on a plastic sandwich box. I powered it from my receiver and spent two weeks trying to make it work. I didn't have anyone to help me in technical matters.

In my ignorance, I was so busy trying to get on the air that I forgot how to listen to a receiver. After a few slow movements of the radio dial, I discovered my sandwich box was getting answers from a distance of a thousand miles or more. I had been so intent on transmitting that the basics of operating a receiver were forgotten. I even went as far as building three separate sandwich boxes, thinking that none were working. It would be interesting to see how many Novices can open one of the new 250-Watt transceivers, work on the vfo, or tear down and rebuild the transmitter if it suddenly goes "whacko!"

My second thoughts lingered on a "quicky" application of an antenna that would work with almost any-

thing. I settled on my favorite, a 15 meter dipole. Its 22-foot length is applicable to most houses without extra devices for installation. My first Novice station used a similar antenna. Again, without proper supervision, I installed the antenna about eight inches above the roof, which is not exactly a good practice if you want the most effective power from your transmitter. But I did work 37 states and four countries before someone told me I should raise the antenna away from the rooftop. I never have.

I soon realized that a person could get carried away in trying to cram too much material into one lesson. Rules and regulations and a run-through of standard operating procedures on the Novice bands were the next step. All this must go on while practicing code.

I got another phone call from Ole George. Still enthusiastic, he informed me that he would soon be by with the money for the Novice rig.

Meanwhile, I had decided that I wasn't a teacher after all, and I proceeded to tell George that I would help all I could, but I would not program instructions on how to become an amateur radio operator. I suddenly realized that amateur radio is dealing with a different breed of individuals who are attempting to become hams. I am referring to the thousands of CBers who want more than CB has to offer. And I was not prepared to deal with them.

No longer are the majority of applicants thirteen-, fourteen-, or fifteen-year-olds studying for the thrill of getting on the air and throwing the big switch to communicate through the magic medium of radio. A majority of this age group who normally would have been lured into the amateur radio service entered the world of communication with 60-100 milliwatt transceivers received Christmas morning and used to play scenes from Star Trek. The thrill of two-way radio is no longer an incentive to become an amateur.

Individual incentives have changed, as has the age group. Basic training is apparently going to have to be more preliminary than ever. The standard prepared Novice material may be too advanced for many. Ole George's education in communication indicated that a lot more is needed than studying for a Novice test to insure proper operation on the amateur frequencies.

One publication reported recently that each month as many as 30,000 new Novices were joining the ranks of amateur radio. Growth and numbers were the most important factors mentioned, not how qualified the numbers were.

I got another phone call from Ole George. I listened to his latest efforts at learning Morse code — four new letters, all printable: E, I, S, and H. He also informed me that he couldn't pay the rest of the money he owed me until the next week.

That took care of George.

The current deregulation efforts by the FCC are beginning to accomplish what a lot of amateurs have been trying to prevent for years — obtaining a license without a great amount of effort — or, in effect, giving away what has been protected through the years. There is no question that the introduction of two-way communication through the Citizens Band has sparked the desired interest to boost licensing in amateur radio and has created more sales for manufacturers, more dues for organizational efforts, more magazine sales, and more political bargaining power. That's the name of the game. But for the serious amateur, it may be too much.

The word "serious" is the word most often used in much of the text written today when describing a ham diehard. Maybe it's time to change that word to "creative." Some individuals tried this approach with the last major proposal concerning the creation of new types of licensing: Communicator, etc., creating a basic separation. It's becoming more apparent that a definite separation presently exists between operators and technicians. It always has, and, with the influx of new blood, this separation will be greater. The loud cry about and finger-pointing at the long list of new license applicants and who deserves the credit (or blame) for them doesn't have much of a bearing on the eventual outcome. Most of these new amateurs are being "created." Most will be operators, not technicians. Many will not have the pride that comes with earning the right to use the frequencies designated by each license.

Enforcing rules and regulations, servicing complaints, and ferreting out violators will soon be the problems facing amateur radio on a much larger scale than ever experienced at any other time. Will amateur radio be ready for it?

There are many amateurs and CB operators who deserve every consideration given with the license they hold, because they have earned the right to speak when and where they please simply by gaining the required knowledge. This article is not intended to belittle their accomplishments nor serve as a deterrent to the many new licensees who have a sincere desire to become good operators . . . but then . . . listen to 75-80 meters for a while . . . what rules and regulations?

Ole George just called. He said, "I learned three new letters, T, M, and O. Dah, dah dah, dah dah dah."

You know, Ole George, you may make it yet. ■

LETTERS

from page 79

THANKS

A terrible thing happened on March 12, 1978: Our house caught fire, and my husband and I received second and third degree burns, plus he was overcome with smoke. We lost almost all we owned. My husband was in critical condition in the ICU for nine days. He came home from the hospital April 7, 1978. My husband is Walt—WB5MWP.

We want to take this way to say thanks and God Bless to each and every one who was concerned about us.

A group on 40 meters opened a special bank account in our names at our bank. Hams from everywhere sent in donations. We have no way of knowing their addresses so we could even send a "Thank You" note.

The money was spent to hire a trained sitter for Walt at night, while in the hospital, so I could come home to the apartment to rest and take care of my burns.

We also bought a new oxygen gauge and oxygen for Walt to use at home. His had been destroyed in the fire.

We thank everyone for all of the get well cards and words of encouragement. We thought this would be a good way to say "Thanks."

Some money that was sent to the bank was from hams we have not talked with. A radio club in Ft. Worth, Texas, "passed the hat" at a meeting and sent the collection to the special account.

The Central States Traffic Net and The Kadiddle Hopper Bunch have been wonderful.

The local hams here just took over and moved some of our things we didn't lose to

Continued on page 87

Ray Brandt W9LIJ
824 N. Marion Ave.
Janesville WI 53545

The IC-22S Scanner

—still another 22S mod

Having wired the accessory socket of my IC-22S to permit remote channel selection, it soon occurred to me that it should be possible to make another accessory for scanning the 22S. The unit described will, in the absence of signal, scan four externally programmed channels within about one second; when a signal appears on a scanned channel, the activation of the squelch release light will stop the scanner on the active channel. When signal is removed, about 8 seconds later the scanning function resumes. Connection through a second diode to the transmit light insures that scanning remains stopped for the same 8 seconds at the end of transmission, should one desire to QSO while in the scanning mode.

As I use my scanner, the three popular local simplex frequencies and the output frequency of the local repeater are programmed for scanning.

Constructional details are left to the reader. I built my unit on a piece of perfboard about 2" x 4½", connecting point-to-point with #24 vinyl hookup wire. The unit is constructed using cheap TTL ICs available generally at Radio Shack or hamfests. Since the IC-22S is readily programmed externally with logic, this is only an example of scanner construction. The use of an MM-454 four-channel commutator would have provided the 4:1 clock countdown on the same chip. I resisted the temptation to use it in this device, since I question its general availability and cost. Other similar devices would have facilitated 6-, 8-, or 16-channel scanning; however, I find 4 to be just about ideal for my local use.

Clock pulses are provided by the 555 timer, at a rate controlled by the 68k resistor and 2 mF capacitor. Considerable experimentation led to the method of disabling the scan on an active channel. The handiest place to get at a control signal in the 22S was desired. This turned out to be associated with the idiot lights just above the signal/power meter. When the green signal lamp is lit, its right-hand terminal drops to nearly ground, resting at 13 V in the absence of signal. Similarly, the left-hand terminal of the red transmit lamp rests at 13 V and is grounded by the PTT switch when transmitting. By connecting the cathode of a silicon diode to each of these points, and connecting their common anodes to a lead from the IC-22S to the scanner, a point which goes to ground whenever the scanner is to be stopped has been provided. This connection is made to the junction of a 150k resistor and 50 mF capacitor shown associated with the 555 timer clock generator. When it grounds, the 50 mF capacitor is discharged,

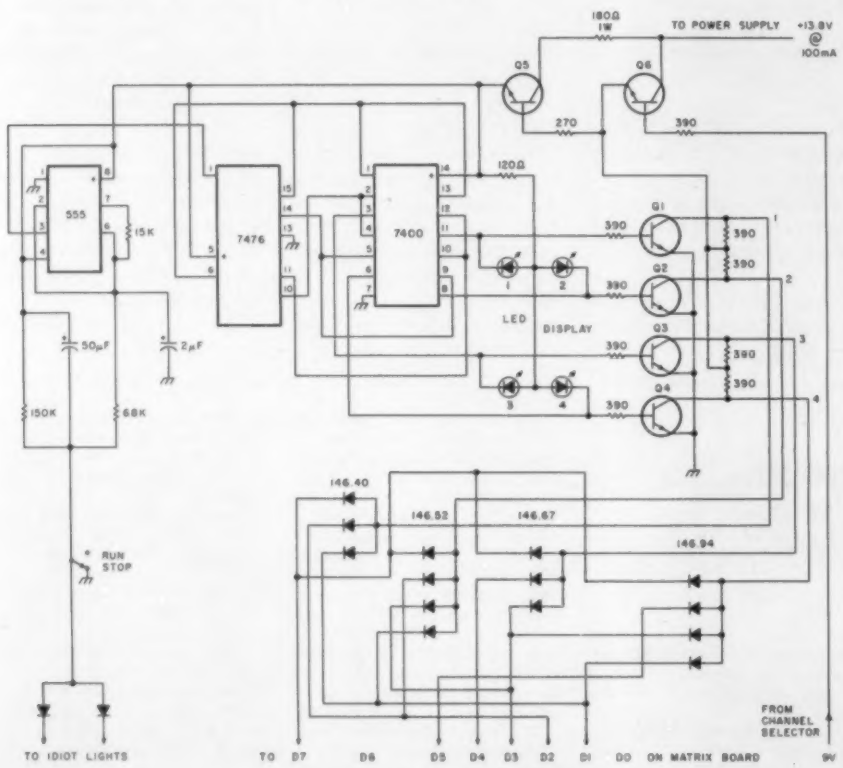

Fig. 1.

stopping the clock pulses. The clock resumes 8 seconds or so later when the ground is no longer present, and the 50 mF capacitor recharges toward 5 V through the 150k resistor.

The output pulses from the 555 drive the clock input of a 7476 dual J-K flip-flop which toggles at the scanning rate. The second flip-flop is driven by the first, by connecting pin 15 to pin 6, causing the second flip-flop to toggle at one half this rate. Four outputs are available from the two flip-flops. Two of these are merely upside-down versions of the other two. To produce a sequence of four from these available waveforms will require some crude processing. The 7400 IC, a quad dual gate, available for even less than the 7476, proved to be the answer.

Refer to Fig. 2. Output 1 is produced whenever inputs a and c are in logic state 1 (up). This occurs only once out of four clock pulses. Similarly, output 2 is produced by the 7400 whenever inputs b and c are up, three when a and d are up, four when b and d are up. The four outputs of the 7400 on pins 11, 8, 3, and 6 each are in the 0 (down) state in rotation 1, 2, 3, and 4.

To produce a channel selection, each diode matrix must have +9 V applied to it in rotation. As can be seen, the output of the 7400 is inverted from what is desired, and does not swing from 0 to +9 V, but swings from 2.8 V to about .8 V. Since most IC inverters would swing through the .8 to 2.8 V range, they are unsuitable. So a series of four general purpose NPN 300 mW transistors were utilized to provide the inversion and a series of outputs swinging between 0 and 9 V. They are cut off one at a time, providing 9 volts to only one diode matrix at a time, in sequence.

Four LED pilot lamps are shown connected to the 7400 outputs to provide conventional scanner indication, conducting one at a time as the scanner operates, stopping to indicate an active channel.

Q6 acts as a switch and emitter follower to produce 9 V for the output transistors from the 13.8 V source, so as not to load the IC-22S 9 V bus as supplied from its channel selector. Q5 senses the presence of 9 V and switches on 5 V to the IC circuits, the voltage drop being almost entirely across the 180 Ohm 1 Watt resistor, thus minimizing its dissipation. The entire unit draws about 100 mA from the 13.8 V supply. About half this current is required by the ICs and LEDs, the balance being shared by the three conducting output transistors. Adding 4 emitter followers would have permitted larger collector resistors and provided a low impedance source to the diode matrix, but the power wasted did not seem worth saving, and 390 Ohms was tolerated by the diode matrix.

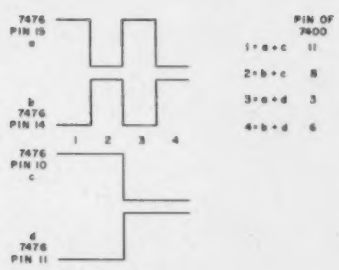

Fig. 2.

Interconnection of the scanner and the 22S to accomplish channel selection can be done in alternate ways; some forethought is indicated depending on how one intends to use the accessory socket. A minimal modification could be employed, using the 9-pin accessory socket to bring out 7 diode leads, omitting the D0 diode (sacrificing offset 15 kHz scanning capability), and having the remaining leads be used by the 9 V common brought out from the channel assigned to external scanner, and for the active channel stop control lead. I devote channel 23 to mine. Just above the channel indicator window at the backside of the switch is a blank pin which has the required 9 V when switched to the green dot which follows channel 22. I covered the other green dot with a small strip of electrical tape to eliminate the confusion of the two green dots.

Probably the preferable method of modification is to install the 24-pin molex connector available from the Icom distributor or service depot to whom the warranty was mailed. A complete connector set is available for about five dollars. Then you can touchtone, too.

If the scanner is to be your only accessory, another method would be to bring out leads from the four channels already programmed in the Icom to the scanner via the 9-pin accessory socket along with the other two. These are numbered along the long edge of the matrix board, as anyone who has programmed his unit knows. Those diodes already on the matrix board can just as well be used for the dual purpose; after all, the selector is on channel 23 to make the scanner run, and they are just sitting in there.

If you decide upon this method, it is recommended that diodes be inserted in each of the four leads to the IC-22S matrix board with their cathodes facing the matrix. This will prevent current being drawn by the scanner when the 22S is used in its conventional manner. ■

LETTERS

from page 85

storage. Hams we used to talk to a few years ago, when we were Novices in Texas, also sent in money to the bank.

Local people brought in food, clothing, bedding, etc. When our home is repaired, we will move back into it.

Our rigs were mostly destroyed, but we hope to get back on the air sometime soon.

Maybe someday, in some way, we can help someone in return for the help we have received.

Thanks again and God Bless.
Sue Kinney WB5MWO
Norman OK

SOUTH SHORE SUPPORT

The 110 members of the South Shore Repeater Association are fully and completely in support of your effort to keep present amateur radio frequencies from being allocated to non-amateurs. The present requirements for amateur radio licenses and the incumbent privileges are not prohibitive or unattainable for any segment of our population. They do serve the positive functions listed below, among others:

1. They require one to *earn* the privilege of operating on these frequencies, and therefore to appreciate and respect these privileges.
2. They encourage more people to acquire related skills and knowledge, thereby increasing the nation's resources in these important areas.
3. Organized amateur radio operators have proven themselves to be very efficient, effective, and valuable in disasters and emergency situations, such as the great blizzard of

Continued on page 89

Computerized Capacity Meter

—cost: $1 plus a computer

Jim Eccleston
1999 Cardinal Crescent
North Vancouver, BC
Canada V7G 1Y3

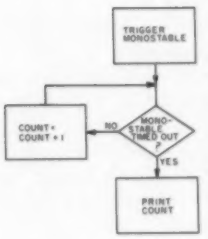

Fig. 1.

I was caught up in the hacker frenzy while attempting the design of some higher-order active filters. Having spent more than a few hours programming my SR-52 to solve cubic and quartic equations, I realized that some heavier-duty number-crunching was called for if I really wanted to obtain those steep skirts. So off I headed to my local friendly computer store, from where I returned several hours later with several heavy boxes and one extremely light wallet.

The kits went together surprisingly well and produced only a couple of minor bugs. I ran in my number-cruncher and design programs and settled back to enjoy the fruit of my labors. Everything was fine and dandy, except for the fact that I now needed several close-tolerance capacitors, but I did not have any kind of a bridge for measurement. Since the state of my wallet precluded the purchase of such an instrument (or even the cost of several 1% capacitors for a one-off filter), I decided to make use of whatever I could find in my junk box to build something that would do the job with a little assistance from the computer.

Overall Design Considerations

The design considerations were simple:

1. It had to be extremely cheap to build.
2. It had to be extremely easy to build.
3. It had to use a minimum of both hardware and software.
4. It had to be reasonably accurate.

The resulting circuit uses only three readily-available components, a small machine language routine (which can be called from BASIC), and the accuracy is limited only by the clock speed of the computer system being used (see Table 1). Rather than give specific details, I thought it best to give a thorough description of the method used together with a flowchart (Fig. 1). This would enable the system to be tailored to any computer, although I have included some code for 8080-based systems as an example.

Circuit Design

The circuit consists of a

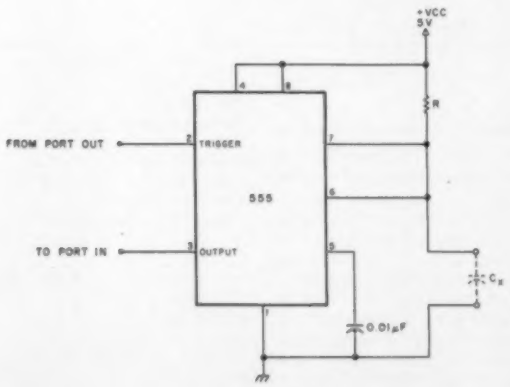

Fig. 2

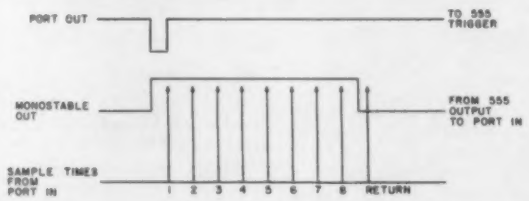

Fig. 3.

```
Top     3E FF       MVI A,OFFH      Make sure trigger
        D3 xx       OUT PORT        is not active.
        21 00 00    LXI H,00        Clear counter.
        3E 00       MVI A,00        Send bit to
        D3 xx       OUT PORT        trigger monostable.
        3E FF       MVI A,OFFH      Reset the
        D3 xx       OUT PORT        trigger.
LOOP    DB xx       IN PORT         Watch the monostable.
        FE FF       CPI OFFH        Is it active?
        C2 xx xx    JNZ OUT         No — go end routine.
        23          INX H           Yes — increment counter.
        C3 xx xx    JMP LOOP        Loop some more
OUT     7C          MOV A,H         routine to pass
        45          MOV B, L        value in H, L back
        CD 9C 0C    CALL 0C9C       to BASIC (MITS).
        C9          RET             Return to BASIC.
```

Program A.

```
10 PRINT"CAPACITANCE METER"
20 A = 0                        Initialize count.
30 FOR I = 1 TO 10              Set up for 10 triggerings.
40 X = USR(0)                   Link to user routine here.
                                X = returned count value.
50 A = A+X                      Add this count to total.
60 NEXT I                       Loop again.
70 B = A/10                     Calculate average.
80 B = B*C                      C is calibration factor.
90 PRINT B
100 END
```

Program B.

```
10 X = USR(0)                   Link to user routine
20 INPUT"ENTER KNOWN CAPACITANCE IN pF" ;Z
30 PRINT"CALIBRATION FACTOR C =";Z/X
40 END
```

Program C.

555 timer chip wired in a standard monostable configuration (Fig. 2).

Circuit Operation

The monostable is triggered under control of an output port bit. Triggering the 555 requires a trigger signal going from a high (+5) level to a low (0) level for a brief period and then returning the trigger signal to a high level (see Fig. 3). The monostable now switches its output to a high level, and this level is sampled at an input port until the monostable times out. While the monostable is timing out, a count is made, and this count is software scaled to equal the value of capacitance that determined the length of the monostable (see Program A).

Software

The whole program can be written in machine language using very little memory, or the count routine can be inserted in memory and called from BASIC via a USR or CALL statement. The example shown in Program B uses a simple BASIC routine which can be expanded to the desired esoteric level. The count from the monostable is averaged over ten triggerings, and the resultant count is then multiplied by a calibration factor to give the value of capacitance used. This count may then be output in whatever form you may choose.

Calibration

Insert a known value of capacitance in the circuit, and run the calibration program (Program C). Enter the result from this program into statement 80 of the main program (Program B). Stray capacitance in the test leads can be calculated by running the program without a capacitor in the test leads and changing the BASIC program to compensate. (Don't forget that you are averaging ten triggerings!)

The representative listing shown (Program A) is from my own breadboarded setup attached to a parallel port, using the high-order data in/out bits. For breadboard purposes, I ran a line from the bit 7 data out to the trigger input and fed the monostable output to the bit 7 data in. The other lines were left floating, which accounts for the bit structures you see addressed to the port in the machine language listing.

Using a 4.7 megohm resistor, my breadboard setup measures from less than 100 picofarads to better than 0.1 microfarads. If you need to cover a larger range, you need only change the value of the resistor and recalibrate. Out-of-range detection can, of course, be accomplished by inserting a software routine to check for a carry during the count and return you a message to change ranges when this occurs. Again, be cautioned, any increase in the size of the count loop will affect the accuracy of measurement.

Timing considerations for the 555 in a monostable configuration are given by T = 1.1 RC. Because of this relationship, this circuit can also be used to measure resistance, though it then needs to be calibrated with a fixed value of capacitance. ■

Capacitance in pF	Accuracy
10	40%
100	4%
1000	0.4%
10000	0.04%
100000	0.004%

Table 1. Assuming count loop for one count is approximately 20 microseconds.

LETTERS

from page 87

February, 1978, in the northeast. Their well-developed and competently handled communications systems were of inestimable value, and they provided selfless sacrifice in time and comfort to provide service and save lives.

4. Because of their technological interests, amateur radio operators continue to improve themselves by constant interchange of technical information, and they often pioneer in new fields such as microprocessors, satellite communications, and other related frontiers.

5. Communications with radio amateurs in other countries have been on a very high plane and have done much to foster good will and understanding around the world.

There are many fine people who operate on Citizens Bands today. Unfortunately, there are too many others who are undisciplined and uncontrollable and use these bands with complete disregard for the rights and feelings of others. They would do much to degrade the frequencies they are now prohibited from using, if these were allocated for general use.

We reiterate that there are no insurmountable restrictions placed in the way of earning radio amateur privileges; anyone of any race or creed can earn the license.

Francis J. DiSabatino K1WGJ
Weymouth MA

NO BREAKERS

I just completed a 2 meter AM QSO with WB2LLV. It was old-fashioned by today's standards—full of reminiscence of the good ole days and 5 minute monologues. There were no

Continued on page 91

A Much Needed Micoder Power Supply

—beats that lily-livered battery

James R. Avoli K3MPJ
1261 Brinton Road
Pittsburgh PA 15221

My umpteenth embarrassment at reaching a wrong number through the autopatch was sworn to be my last . . . well, almost my last, anyway.

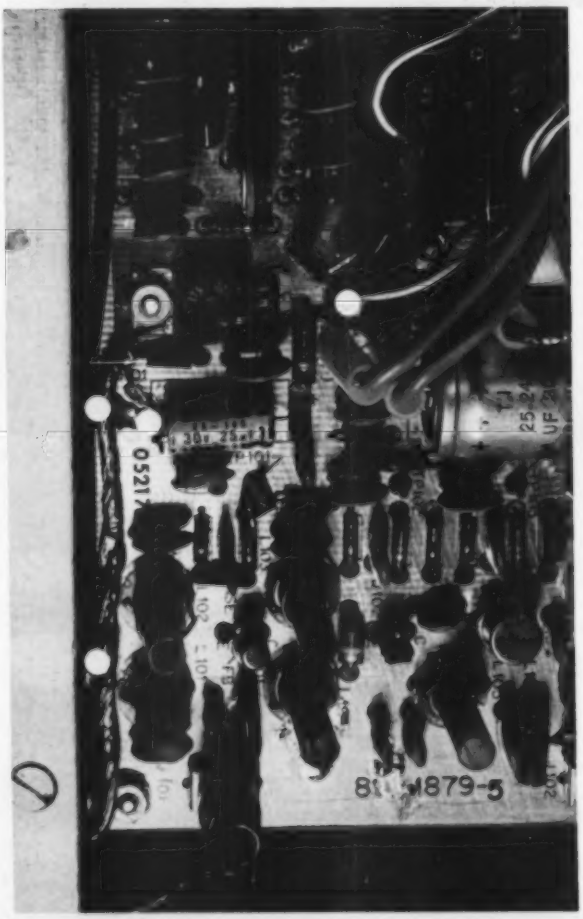

Photo A. Points of interest are indicated by the white dots.

At first, I thought the problem was coming from road noise inside the car being transmitted along with the tones because of an open (live) microphone. But I kept getting unreliable results while trying to cover the mike while dialing.

The real problem became more obvious when I noticed that the LED tone indicator glowed unusually dim one night. It seems that, with daily use during rush hours and a few QSOs from the QTH throughout the week, the internal battery voltage falls off to about 8 volts within a month. The microphone still works fine, but the tone generators run slightly off frequency, and that's the most deceitful way to get wrong numbers through any autopatch. The repeater's decoders gave the benefit of the doubt when accessing the autopatch, but Ma Bell was just too critical.

The folks at Heath have chosen to power their cleverly-designed Micoder from an internal 9 V transistor radio battery. If I may, I'd like to second-guess that the reason for this was so that it could sell on the amateur market as an accessory item for any transceiver. But, in their infinite wisdom, they forgot about their primary prospects — the owners of the HW-2036, one of the best kits I have known them ever to have marketed (but that's another story). What they forgot was that, for the small cost of one more conductor in the coiled cord and a couple of additional components, they could have produced a far more superior product. And that's exactly what this article is all about.

Bye-Buy Battery

My solution was to replace the coiled cord with one having an extra (shielded) conductor, Belden's #8491, which retails for $3.98 plus tax. Using that extra conductor proved to be an easy task. I channeled it past the transmitter, grounded the shield to C155, and connected the center conductor to the wire leaving pin W. This now supplies 11 volts

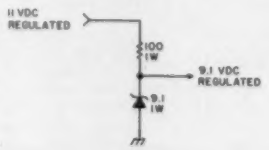

Fig. 1.

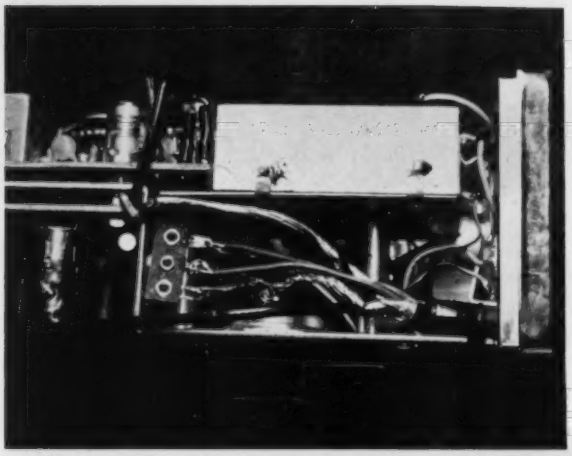

Photo B. Detail of the routing of the additional conductor.

Photo C. Interior of upgraded Micoder: (a) zener diode, (b) 1-Watt resistor, and (c) no battery.

(regulated) to the Micoder. Since it will draw less than 10 mA, Q104 is still within its safety rating. Since the HW-2036 is primarily a mobile unit, my better judgment forced me to tack this wire and the "long cable" (as the assembly instructions called it) to the chassis with two dabs of epoxy glue, as illustrated in Photo A. When the remaining wires of the replacement coiled cord are connected to terminal strip AT, be careful of two things: (1) Don't damage C1 (22 uF tantalum), and (2) pay careful attention to which shielded lead was used for the audio conductor and which one was used for the voltage conductor (one black center conductor is solid black, while the other black center conductor is black over white). See Photo B.

Meanwhile, back at the Micoder, I removed the battery and its connector and grounded both shields from the coiled cord. Then I constructed the secondary 9 V regulator, as shown in Fig. 1. I used a General Electric GEZD-9.1, which retails for 90¢ plus tax, and, for no other reason than that the zener diode has a 1-Watt rating, I used a junk box variety 1-Watt, 100-Ohm resistor (where a 1/4 Watt would have sufficed). Then I packed both components in the crevice beneath the PTT switch actuator, as shown in Photo C.

Now comes the smoke test. I attached a voltmeter to the nine-volt point and powered up. Success! I transmitted — still nine volts, and the repeater keyed up. Success again!

I announced myself and got a response, so I knew the microphone worked. I calibrated the tone generators and brought up the autopatch. Ah, total triumph at last — no more wrong numbers, no more embarrassments. And it had cost me only about five dollars, which is cheap by anybody's standards.

Enter Dr. Murphy

In my own inimitable way of patting my own back, I had forgotten all about Murphy's Law #719 (Italian fingers can still dial incorrectly), #722 (phono-plug-style antenna connectors can still fall off when the transceiver is accosted by a Pittsburgh pothole after the number is dialed but before the connection is established), and #745 (at least 5000 other hams are reading the mail during the time frame that the above embarrassments are being perpetrated). Humbug! ■

LETTERS

from page 89

breakers, time outs, QRM, QSB, TVI, or BCI. Now, it's been a long time since I have had a 1-hour QSO and years since I've had a QSO without the "normal" hassle we have grown to accept. Wayne was mentioned in the remembrances of the big pileup and the signal that W2NSD/1 would belt out from N.H.

This note is not intended to get you thinking of the old days, but rather to point out that there are a lot of operators who don't know of the old days. I rather suspect that a small percent of all present 2 meter operators really know the capability of the band. Their experience is limited to the local repeater range. The jerks in Washington have now set the conditions to put the local repeater everywhere. It's small wonder that I bought a mint Gonset III for $10 last weekend (my II is still a better rig). I also bought a Clegg Thor 6 for $75. Now, how many of the kids, lids, and school bus riders have felt the thrill of a 6 meter opening (or even know of 6m)? Get your typewriter going, Wayne, and tell the kids what is available. Put NSD/1 on the VHF/UHF bands 2 or 3 nights a month to remind the northeast what can be done.

No, I am not the recluse hanging on to youth. I operate 160 through 3/4 meter SSB, CW, AM, SSTV, and 2 FM, and Oscar A and B. The lost art of rag chewing can be best practiced on VHF AM.

Chris Schlotz W2HKW/K2PGB
Ringoes NJ

P.S. CW within 25 kHz of the lower band edge is a great place for DX. The CB converts will buy linears, but they refuse to practice CW. Both of my converts have virtually forgotten the code.

Bill Johnston N5KR
1808 Pomona Drive
Las Cruces NM 88001

Your 'Scope Can Be Improved

—*simple calibrator*

The oscilloscope is one of the most versatile instruments in the ham shack, and it would probably take an entire book just to list its many uses. Quite a few of the lower priced instruments, however, are handicapped by the fact that, though they can faithfully display the shape of the waveform under examination, they cannot be used to accurately measure the amplitude or the frequency of the signal. This is true not because there is anything wrong with the instruments themselves, but simply because most of them do not have built-in calibration circuits, or they have only very rudimentary ones.

Amplitude calibration is normally carried out by applying a signal or voltage of known amplitude to the vertical input of the oscilloscope and adjusting the vertical gain control until the displayed signal spans a given number of divisions on the reticle. You then have a known calibration value in volts per division (V/div.), and the amplitude of any unknown signal or voltage can be read directly from the screen.

The scope's vertical input attenuator can be used to accurately measure higher voltages. For example, if you calibrate the scope to read 1 V/div., then, by simply turning the attenuator switch to the X10 position, it will be calibrated at 10 V/div. You can go the other way, too. For example, start out with the attenuator in the X10 position and calibrate the scope to display 1 V/div. Then turn the attenuator back to X1, and the scope will be calibrated at 0.1 V/div. (i.e., 100 mV/div.).

Frequency measurements are handled in a similar fashion, but by using the horizontal sweep frequency and/or gain controls to calibrate the horizontal axis such

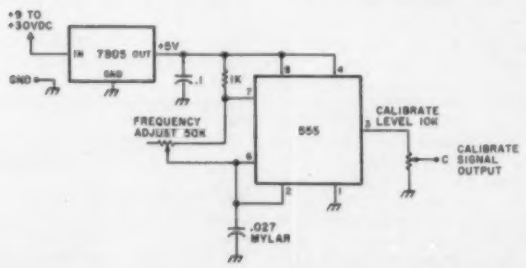

Fig. 1. Circuit diagram of the N5KR oscilloscope calibrator. It uses only seven components, all of which are readily available.

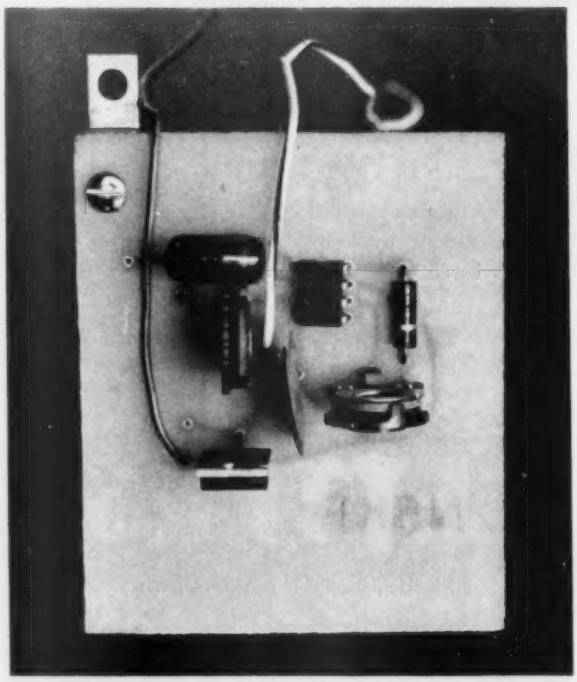

Fig. 2. Photograph of the finished board ready for installation in the scope. The trimpot at the lower right sets the frequency, while the one toward the left sets the amplitude of the calibrate signal.

that the signal of known frequency is displayed with a given number of cycles per division. The frequency of an unknown signal can then be measured by noting the number of cycles per division it occupies on the screen.

My own oscilloscope had a built-in calibration signal, but it consisted of nothing more than an extra winding on the power transformer to supply 1 volt peak-to-peak at 60 Hz. Consequently, any line voltage changes would cause the amplitude of the calibration signal to change by the same percentage, which was entirely unacceptable for accurate measurements. The frequency was that of the line itself and, consequently, extremely accurate. However, 60 Hz is such a low frequency compared to the signals normally being measured in the audio range that the measurements which are possible in theory are not possible in practice because of the great percentage difference (that is, the ratio) between the reference signal and the unknown signal.

The solution to all these problems is the circuit shown in Fig. 1, which generates a stable square wave calibration signal and costs less than $3.00 to build. The component values shown have been selected to provide a symmetrical 1-volt p-p signal at 1000 Hz when the two trimpots are calibrated. The 555 timer generates the signal at a stable frequency, while the 7805 regulator ensures a fixed amplitude. The entire circuit contains only seven components, which are mounted on a small PC board as shown in Fig. 2. The 1 V p-p signal enables fast and simple calibration of the scope in the vertical (amplitude) axis, and the 1000 Hz frequency is a nice round reference frequency for analysis of most audio signals. The circuit board is small enough to mount inside of the oscilloscope itself, with the few milliamps of power required being supplied from the scope's existing power supply.

Construction

The circuit is simple enough to build on perfboard, and parts layout is not critical. I built mine on a small PC board, the layout for which is shown in Fig. 3. Parts placement, as viewed from the component side, is given in Fig. 4.

Component tolerances of 20% are satisfactory, since the two trimpots are used to make the final amplitude and frequency adjustments. In fact, the .027 uF capacitor can be substituted for with any value from .02 to .047, if you don't have a .027, but it would be better to go lower in value rather than higher, if you have a choice. The important thing is that this capacitor be of mylar or other temperature-stable type. The PC layout shown in Fig. 3 has two different solder pads (one on an extension) on the ground side of this capacitor to accommodate whatever capacitor you select, since its physical size may be different from the one I used. There are also a couple of extra solder pads for making an external ground connection, if desired.

The 7805 regulator may be substituted for with an LM340T-5, which is the same device. On rare occasions, these regulators have been known to go into self-oscillation. Should you encounter this problem, replacing the .1 uF disc capacitor with a 1 uF tantalum capacitor should clear it up.

Mounting and Power Connections

The circuit is so small that it can be mounted almost anywhere in the scope. In fact, you can trim the PC board down a lot smaller than the one shown in Fig. 2, which has a lot of blank space around the edges. You should, however, make it a point to mount it as far as possible from major heat sources so that the calibrator's frequency stability won't be impaired.

Fig. 5 shows my own installation, where the calibrator board is supported by a single Z-bracket fastened to the chassis (in the lower right-hand corner, toward the rear of the scope).

The input voltage can be anywhere from +9 to +30 volts dc, and you won't have any trouble finding a supply voltage somewhere in this range in a solid state oscilloscope. If your scope is tube type, you might still find a voltage of the proper value, but if not, you can obtain it from a higher voltage through an appropriate voltage divider. The supply voltage doesn't have to be regulated, but, on the other hand, you want to avoid one that fluctuates widely. The negative (ground) connection can be made through the mounting bracket, if desired.

If your scope has an existing jack on the front panel for a calibrate signal, just disconnect the wire from the existing calibrate signal and run a new wire from the jack to the calibrate signal output (C) on the circuit board. If you don't already have a jack or if you want to retain your existing calibrate signal, you will need to mount a small pin jack on the front panel for this connection.

Calibration

In order for the calibrator to be of any use, it must itself be calibrated in an accurate manner, and the circuit has been designed for simplicity in that respect. First, set the two trimpots to mid-scale. Now, with power applied to the calibrator circuit, use a VTVM or other accurate voltmeter to measure the calibrate signal at C. Set the voltmeter to read "dc volts," and adjust the 10k pot until the meter reads exactly one-half volt (0.5 V). Fig. 6 shows the reading being taken for this adjustment. The square wave at the output now has a peak-to-peak amplitude of exactly 1 volt.

What you have done here is used the dc voltmeter to measure the average output voltage, and, since the signal

Fig. 3. PC layout, foil-side view.

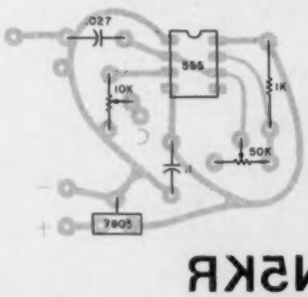

Fig. 4. Parts placement, component-side view.

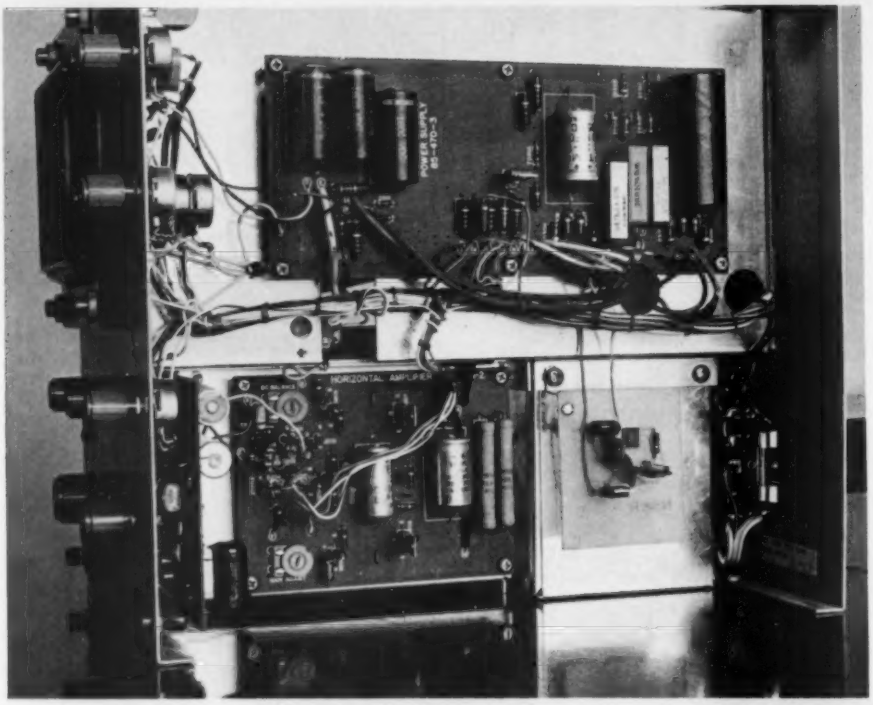

Fig. 5. A typical installation of the finished calibrator in an oscilloscope (lower right corner, toward the rear of the scope). Placement is not critical, but you should avoid areas of high temperature so that its frequency stability won't be impaired.

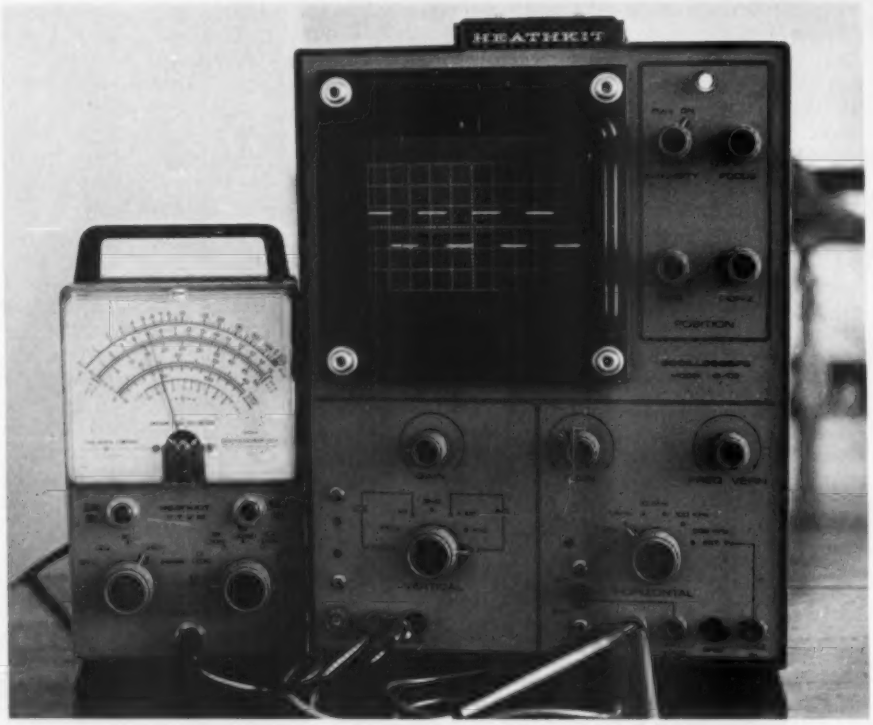

Fig. 6. Adjusting the calibrator output to 1 V p-p gives a reading of exactly 0.5 volts when the voltmeter is set to read "DC VOLTS." This eliminates the need for an expensive instrument to accurately set the amplitude of the calibrator waveform.

is switching back and forth between 0 volts and 1 volt, the average value you read on the meter is 0.5 volts. This is true only for a symmetrical square wave, of course, and the component values in this circuit have been chosen such that any error in symmetry is less than 1% at 1000 Hz. You also have to be assured that the negative (low) half cycle of the signal is actually at zero volts, which it is, for all practical purposes, when the 555 is operated at the 5 V input voltage supplied by the 7805 regulator.

The easiest way to set the frequency is to measure the calibrate signal with a digital counter. If you don't have access to one, an accurate audio signal generator can be used, with the calibrate signal frequency being adjusted to match the known signal while they are being watched on the scope. In any case, the frequency of the calibrate signal is adjusted with the 50k pot.

If you prefer a frequency other than 1000 Hz, you can set the pot for a lower frequency without hurting anything. If you set the pot to a higher frequency, though, the symmetry of the waveform will be upset. To go to a higher frequency, you should lower the value of the .027 capacitor instead, using the formula:

$$C = 28/F,$$

where C is the value in microfarads of the new capacitor, and F is the desired signal frequency.

Summary

This is one of those satisfying projects that you can put together in an hour or so, at a cost of only two or three dollars, and see the results immediately. It consists of only seven components, which are available from any retail or mail-order electronics dealer. It's a handy little device that will enhance the utility of lower cost oscilloscopes, and you can sit back and enjoy using it for years to come. ■

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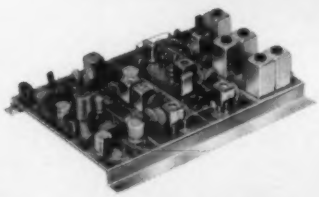

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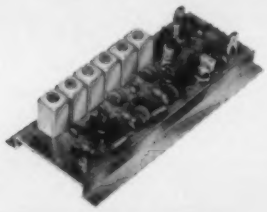
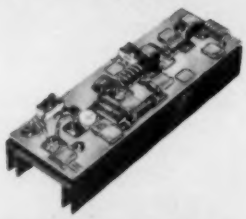


TX50 1 watt true fm 6 meter transmitter
Kit $44.95



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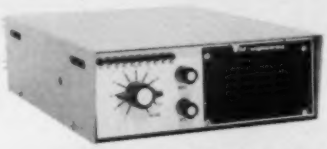

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Robert F. Cann W4GBB
1606 Lochwood Dr.
Richmond VA 23233

How About SSB CB Conversions?

—no strain

After almost 20 years of hamming on the low-frequency bands, I have become very disillusioned with the QRM and crowded conditions that exist. After a short time with 40 meter QRP and 2m, I decided to explore the new frontiers of the 10 meter band. Since I am a QRP advocate and a member of the QRP Club International (QRP #3214), I began my 10 meter activities with a converted AM CB rig and a vertical CB antenna. The results were very rewarding, and, in January of this year, I began looking for an SSB CB rig to convert.

The Kraco Model KB-2355 described in this article was selected because of its price (under $140 at a local department store sale), and closer examination revealed features that are desirable in a modern ham rig. (See Table 1.)

In addition to those features, the Kraco has dual meters for received signal and power/swr, a switchable noise blanker for SSB, and a switchable noise limiter for AM. Although the unit is larger than most CB rigs (13" x 4" x 10"), it is an excellent size for base station operations and leaves enough room internally for those who wish to add a receiver preamp or a small linear amplifier.

Since this unit uses 10 crystals in the 23 MHz and 14 MHz range to achieve synthesis action, it is only necessary to change the four 14 MHz crystals to achieve 10 meter coverage. Table 2 shows the original frequency scheme and the new crystals added to give you 10 meter coverage. You may wish to use different crystal frequencies for the high end of the band, since there has been increased activity above 29 MHz. Fig. 1 indicates the location of the crystals on the 23-channel switch deck.

The crystals in the Kraco are the HC-18/U type, and, in order to gain access for soldering, it will be necessary to remove the front panel and remove the 2 Phillips-head screws holding the push-button switch deck in place. Once this is done, the switch deck can be moved aside to allow access to the underside of the crystal board.

Once the 4 new crystals have been installed and the switch deck and front panel have been put back in place, you must retune the transmitter and receiver sections. The only equipment necessary is an rf signal generator, and the procedure should take no longer than 30 minutes.

With the signal generator tuned to the center of the frequency range that you have chosen, proceed as follows:

Crystal switch: Ch. 11 or 12
Mode switch: AM

Tune the following coils, in the sequence listed, for a maximum indication on the S-meter:

1. L202
2. L203
3. L204

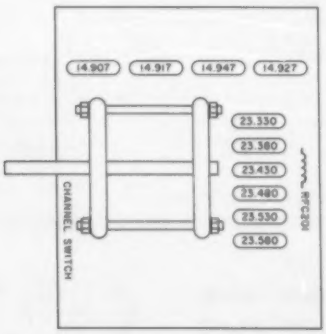

Fig. 1. Placement of crystals on the crystal board. The original crystal frequencies are indicated.

General	
Frequency control:	10-crystal synthesis configuration
Mode of operation:	AM, USB, and LSB
Power source:	110 V, 50-60 Hz, 11-16 volts dc, negative ground
Receiver	
Sensitivity:	AM – 1 μV for 10 dB (S+N)/N SSB – .25 μV for 10 dB (S+N)/N
Bandwidth:	4 kHz at 6 dB down for SSB and AM
Image Rejection:	40 dB
Offset tuning:	±1 kHz
Audio output:	3 Watts at 8 Ohms
I-f frequency:	11.2735 MHz for SSB and AM
SSB Transmit	
SSB generation:	Balanced ring modulator with crystal lattice filter
Rf output:	12 Watts PEP
Carrier Suppression:	40 dB down
Harmonic Suppression:	50 dB down
AM Transmit	
Modulation:	High level class B
Rf output:	4 Watts
Harmonic Suppression:	50 dB down

Table 1.

4. L18
5. L19
6. L20

Place the mode switch in the LSB position and continue:

1. L13
2. L14
3. L15
4. L16
5. L17

This completes the receiver alignment for all modes. Now disconnect the signal generator and connect a dummy load or two 100-Ohm, 2-Watt resistors across the coaxial antenna jack. With the mode switch in the AM position and while pushing the mike switch for short durations, tune the following coils in the sequence listed for a maximum indication on the rf meter:

1. L1
2. L2
3. L3
4. L4
5. L5
6. L6
7. L7
8. L601

This completes the basic conversion, and, if you have used the same crystals that I have, you are now ready to work 10 meters on any 23 channels between 28.55 and 28.83 MHz. However, you are rockbound and the success of any QRP rig is its ability to move around with continuous coverage. This problem is solved with the following modification:

1. Remove the front panel and push-button switch deck as previously indicated.

	ORIGINAL			CONVERSION		
Channel	X201 through X206	X207 through X210	CB Frequency	X201 through X206	X207 through X210	10 meter Frequency
1	23.330	14.907	26.9635	23.330	16.492	28.5485
2		14.917	26.9735		16.502	28.5585
3		14.927	26.9835		16.512	28.5685
4		14.947	27.0035		16.532	28.5885
5	23.380	14.907	27.0135	23.380	16.492	28.5985
6		14.917	27.0235		16.502	28.6085
7		14.927	27.0335		16.512	28.6185
8		14.947	27.0535		16.532	28.6385
9	23.430	14.907	27.0635	23.430	16.492	28.6485
10		14.917	27.0735		16.502	28.6585
11		14.927	27.0835		16.512	28.6685
12		14.947	27.1035		16.532	28.6885
13	23.480	14.907	27.1135	23.480	16.492	28.6985
14		14.917	27.1235		16.502	28.7085
15		14.927	27.1335		16.512	28.7185
16		14.947	27.1535		16.532	28.7385
17	23.530	14.907	27.1635	23.530	16.492	28.7485
18		14.917	27.1735		16.502	28.7585
19		14.927	27.1835		16.512	28.7685
20		14.947	27.2035		16.532	28.7885
21	23.580	14.907	27.2135	23.580	16.492	28.7985
22		14.917	27.2235		16.502	28.8085
23		14.947	27.2535		16.532	28.8385

Table 2. With an i-f frequency of 11.2735 MHz, final frequency generation is offset 1.5 kHz for SSB. Only the four 14 MHz crystals need to be changed for 10 meter coverage.

2. Place short jumper wires across the miniature netting capacitors associated with the four added 16 MHz crystals. These are indicated as TC201 through TC204.

3. Remove the end of RFC 201 (on crystal board) which connects to the low side of the netting capacitors you just shorted out.

4. Connect a miniature tuning capacitor (approximately 170 pF) in series with RFC 201 and its original connection on the board. I used a miniature tuning capacitor from a transistor broadcast radio for this purpose.

5. Remember that this capacitor must be insulated from ground, so I will leave the physical mounting up to you. A method that worked well for me and did not disturb the appearance of the front panel too much was to mount the capacitor on a small U-shaped bracket and bring an insulated shaft through the pilot light hole at the right of the crystal switch.

With the addition of this capacitor in series with the low side of the 16 MHz crystals, you will achieve approximately an 8 to 10 kHz swing on each of the 23 channels. You have advanced from rockbound to vxo-controlled and have achieved the flexibility necessary for QRP.

I have been using this rig with much success for the past year and have worked six continents and all fifty states. As most of my contacts have stated, the rig has excellent audio quality and, with my 4-element 10 meter beam, has a good punch.

After having so many inquiries on the air and after reading the comment by Wayne in the June issue of *73 Magazine*, I decided to share this information with you. My final modification on the rig will be to add a CW mode, and I would welcome any comments or suggestions on this. ■

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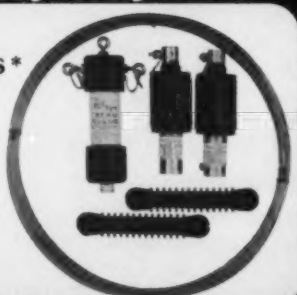

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The Universal Notcher

—*easy as pi*

I have long been thinking about writing articles on construction projects whose main advantages are the use of a PC board for error-free and repeatable circuits, the neatness of a PC board, because it cleans up the inevitable wiring that accumulates in any ham shack, and its high use-to-simplicity ratio (one board: many uses). This is the first article of that type, describing an audio notch filter. The board is laid out for 2 channels of audio (stereo) for my use, but it can be half built or split down the lettering on the board for two separate filters.

Anything I have come up with on this lesser-used type of audio RC filter I will list in the references for those who want further history on it.

I use this filter at the phono inputs of a stereo amplifier/cassette tape deck combination to eliminate any hum (60 Hz stray) picked up over long lines (6-12 feet) from the EME rack to the console, where the amplifier and tape deck reside in a drawer for easy use. Those of you who are CW-operator types may see its obvious use as a notch filter that can be ganged in parallel to knock out 2 adjacent beats or used to bracket the desired signal in a bandpass style. Other possible uses are: with an op amp IC bandpass style as an easily tuned/no coil i-f amplifier; as the oscillator frequency determining element in a bfo or variable frequency audio generator; as slot filters at other frequencies than 60 Hz (notch out loran signals at VLF?); and the list goes on! Perhaps the best thing this RC network has over others, the twin-tee for example, is the fact that it "tunes" with only the single pot, R_{fa} in the schematic.

The very simplicity of the

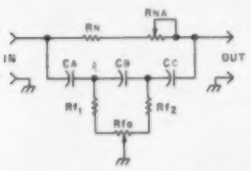

Fig. 1. Schematic (one channel). $R_n = R_{null}$; R_{na} = null adjust; R_{f1} and $R_{f2} = f_{limit}$; R_{fa} = frequency adjust. General formulas: 1) $f_o = 1/2\pi C_X\sqrt{3(R_X)^2}$, where R is in Ohms, $R_X = R_{f1} + R_{fa}/2$, and C_X = any Ca, Cb, or Cc. This allows f_o of interest at R_{fa} centered. 2) $R_X = 1/(\sqrt{3})(2\pi)(f_o)(C_X)$. 3) $C_X = 1/(\sqrt{3})(2\pi)(f_o)(R_X)$. 4) $R_n + R_{na} = 6[(R_{f1} + R_{fa}/2) + (R_{f2} + R_{fa}/2)]$.

	R_{fa}	R_{f1}	R_{f2}	Ca	Cb	Cc	R_n	R_{na}	$R_n + R_{na}$
Example 1:									
60 Hz									
calculated	10k	[5672.1Ω -	$(R_{fa}/2)$]	[.30629 x 10^{-6}]					68160 Ω
Actual used	10k	680	680	.27	.27	.27	56k	25k	
Example 2:									
500 kHz									
calculated	10k	[5568.9 -	$(R_{fa}/2)$]	[3.6 x 10^{-11}]					66826.8 Ω
Actual	10k	560 Ω	560 Ω	33 pF	33 pF	33 pF	56k	25k	

Table 1. Use good quality mylar capacitors and 5% resistors for filter performance. Example 1: 1 dB insertion loss and 62 dB notch @ f_o = 60 Hz. Pots used were PC thumbwheels, but R_{fa} can be panel mounted. Using actual values in example 1, null frequency at R_{fa} center = 59.9166 Hz. The filter is an RC phase shift type and works best in moderate- to high-impedance circuits (i.e., phono inputs, etc., of 50k to 1 meg). This can be used in loop of op amps like the twin-tee variety. Example 2: insertion loss = 1 dB; null = 42 dB.

filter allows me the brief following description of its operation. Picture the sine wave 60 Hz example entering the input. It travels through R_n and R_{na} and appears in phase at the output at some level dependent on the setting of R_{na}. Meanwhile, the same sine wave travels through Ca and $R_{fl} + R_{fa}/2$ to ground, causing a phase-shifted voltage to appear at the junction of Ca, Cb, and R_{fl}. This second voltage passes through Cb and $R_{f2} + R_{fa}/2$ to ground, causing a further phase shift at the junction of Cb, Cc, and the output load impedance to ground for the final shift. Ideally, this shift amounts to 180° at f_o (60 Hz), and the signals totally cancel each other at the output when R_{na} is adjusted to equal the amplitude passing through the capacitor string. Or, again ideally, (+V null leg) + (-V capacitor leg) = 0 V. Board leakage, component tolerance, etc., prevent the ideal as in most electronic circuits, but 40 to 60 dB+ isn't too shaggy!

Try your own ideas out, and don't be afraid of frequencies at least up to middle i-f range (500 kHz or so), as all mine seemed to do fine. Above this, leakage and shielding become a definite problem, but, if you are brave, plug on. My main reason for this article is to give you the idea and a PC board layout to play with. I'm sure that as hams you can imagine the rest. ■

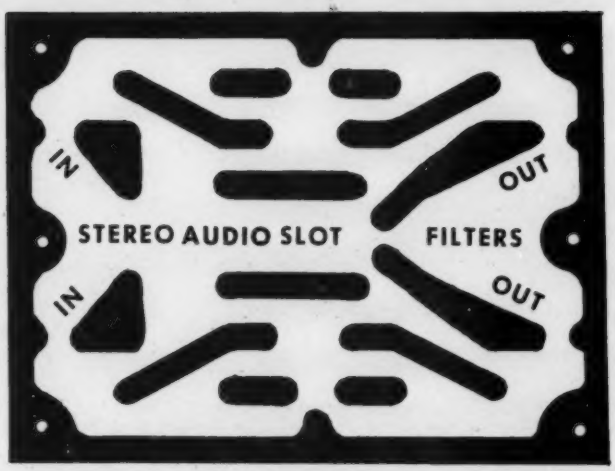

Fig. 2. Copper foil pattern.

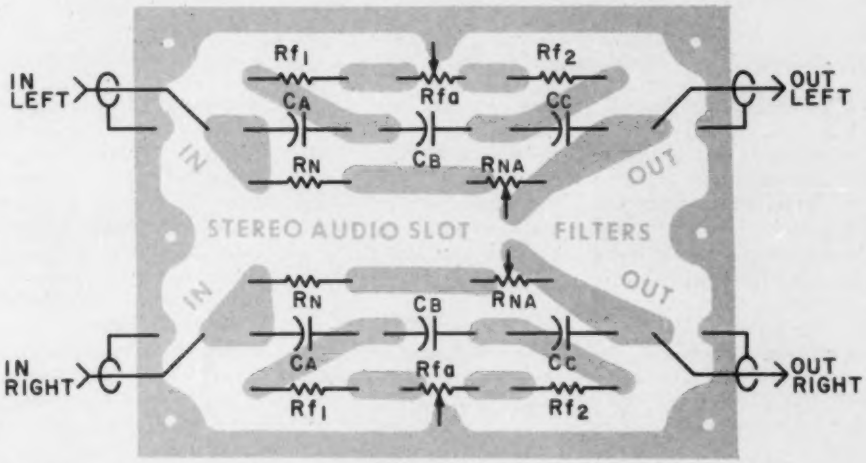

Fig. 3. Bottom view, copper side. Board may be split along lettering for two separate filter boards.

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WA5SNZ, *Ham Radio*, September, 1975, p. 16.

IRE Transactions, September, 1955.

General Radio Experimenter, July, 1961.

EEE Magazine, October, 1969.

Mike Kossor WA2EBY
13 North 12th Street
Kenilworth NJ 07033

The $5 Memory Keyer

—*for lazy cheapskates*

Sending CQ can become a tedious task. Some people really indulge and buy an auto-keyer with a memory to do the job for them. But, if you don't have at least one hundred dollars to spend, it's doubtful that you will find one at all.

The following project is not a keyer. It cannot be used with a paddle. However, it does have the capability of storing several hundred bits of information in its memory which can be used to key a transmitter with a key terminal voltage of up to four hundred volts and as high as six Amps, which covers just about all modern equipment on the market.

With a regular auto-keyer, many coils and complex circuitry are used to achieve its operation. The device described in this article is considerably less expensive than these units and will allow the operator to send CQ just as quickly and easily. Instead of complex circuitry, this device uses information stored on magnetic tape, which most of you probably already have.

The circuit takes audio pulses from a tape recorder and changes them into on-off keying pulses to key the transmitter. Therefore, whatever you can put on tape, you can put into the "memory" of this new tape keyer. Additionally, a repeating cassette tape can be used, so no rewinding of the tape is necessary. After the tape has completed the CQ, just stop it. If there is no answer, just start the tape again. However, a standard cassette will work fine.

Fig. 1. Block diagram.

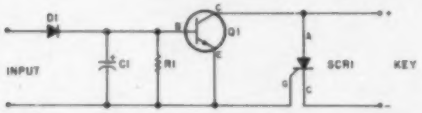

Fig. 2. Schematic diagram of the tape keyer. C1 – 1000 uF, 16 V dc electrolytic; D1 – 1N4004 diode; Q1 – RS 2020 (Radio Shack); R1 – ½ Watt, 22 Ohms; SCR1 – RS 1020 (Radio Shack).

Hookup and Operation

The tape keyer is assembled on a printed circuit board and enclosed in a small box. Parts placement is not critical, and the tape keyer may be hand wired, if desired.

A standard code practice oscillator is used for programming. CQ or anything else is recorded on the tape. Once programmed, the audio output of the tape recorder is fed into the tape keyer. The outputs of the tape keyer are connected to the key terminals of the transmitter (refer to Fig. 1, the block diagram). Polarity of the key terminals must be observed so that SCR1 stays reverse biased until turned on by Q1.

The volume of the tape recorder should be turned up until full keying is achieved and complete dots and dashes are heard. For best results, when programming the tape, record directly using no microphone from the oscillator output to the recorder's microphone input.

Circuit Theory

When the audio signal is positive at the anode of D1, capacitor C1 is charged and Q1 is forward biased. This turns SCR1 on and keys the transmitter. When the polarity reverses, C1 discharges, keeping Q1 forward biased. When the audio signal ceases, resistor R1 is used to discharge the capacitor at a fast rate, so that Q1 turns off, which stops SCR1 from conducting. ■

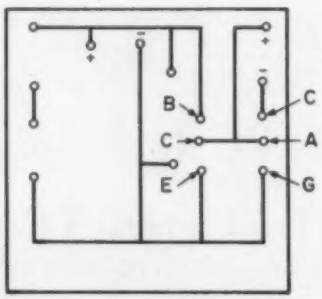

Fig. 3. PC board – foil side.

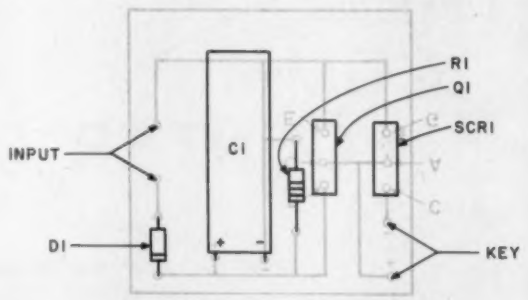

Fig. 4. PC board – parts placement.

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Should Repeaters Use Subaudible Tones?

—*theological argument*

This article was written with two purposes in mind. First, it tells the average VHF repeater user that PL need not be a barrier to accessing a local repeater, but can be a tool for improving the operation of both repeater and user station. Second, it is an approach to improving the problems of mutual repeater interference, particularly during band openings, which should be studied by repeater owners and repeater councils alike. Various aspects of this approach have been proposed by repeater councils and owners in the past, and a few machines are using something similar to this approach now. This article tells about two machines in Illinois, both on the same frequency pair, which have reduced their mutual interference by using the system described here.

Mention subaudible coded access or Private Line (PL)* to any mixed group of VHF repeater oriented hams, and you're likely to get widely divergent reactions. The average repeater user hates it, the average *private* repeater user or owner considers it to be God's gift to ham radio, and the average repeater control operator is likely to be ambivalent about it.

*Private Line is a trademark of Motorola, Inc. Other names for such continuous subaudible tone coded access systems are Channel Guard (GE) and Quiet Channel (RCA). Since amateurs are most familiar with the term PL, however, I will be using this throughout the article.

On the positive side, PL and its related coded access systems provide a means of keeping out transmissions that do not intend to access the system. This keeps the extraneous key-ups at bay and thus provides a measure of sanity insurance for the control operator. It also partially insures keeping the private system private. That is also a negative, to the outsider, but that argument is beyond the scope of this article.

On the negative side, there is the problem of emergency traffic attempting to access the system and the problems which that presents to the control operator involved. And, there are the twin hassles of the cost of PL (to the stingy) and the various problems involved in installing it in the average small VHF rig.

However, there are times when the repeater owner or control operator, especially in crowded repeater areas, sees the need for some form of coded access for his machine. Just think for a moment about repeaters located near seacoasts or other areas where tropo ducting on VHF is common. One tropo duct can equal one mess.

Here is how one repeater organization, with the help of another, took a big step toward resolving both the PL and the interference problems, to the benefit of both machines.

WR9ABQ is owned by the Valley Amateur Repeater Association (VARA) of Elgin, Illinois. Their two meter system operates on the 19/79 pair. Other "neighbor" repeaters on that pair are WR9ADF in Normal/Bloomington, WR8ABI at Oshtemo/Kalamazoo, and WRØAJC in Burlington, Iowa. In the early days of "ABQ," when the band would open up, users of these machines would unintentionally "drop in" on the Elgin machine's input frequency, with the usual disruptive results.

That's not happening nearly as often anymore. The technical committee at VARA, after facing these frustrations for some time but not wishing to "close" their repeater via PL, came up with the idea of using PL as a carrier squelch *loosener*, rather than as a squelch of its own. The user who keys up the machine using its PL frequency automatically buys himself an added 6 dB of carrier squelch threshold. That feature alone brings down the number of key-ups from distant, tropo-propagating stations which do not intend to access the system. Without the right PL, they have a much harder time getting in.

Any repeater which chooses to use the PL system just described has the flexi-

bility of choosing how much to loosen the squelch with detected PL or, rather, how much to tighten things down when carrier and no PL are present. How much is, of course, up to the individual repeater's particular interference situation. The best setting is determined experimentally.

In addition to the foregoing, WR9ABQ also makes judicious use of anti-PL, which, for the uninitiated, denies access for the user of the anti-PL tone rather than assures it. At the present time, WR9ABQ has one anti-PL frequency, which is the access tone frequency used at WR9ADF in Bloomington. Fixed stations and high-powered mobiles use this frequency both to enhance their chances of getting into their home repeater and as a courtesy to the next repeater on the same pair. Such users simply do not get into WR9ABQ. The people at WR9ADF have also installed their own anti-PL system, which is tuned to the VARA PL frequency. This results in a lot less mutual interference between these two repeaters than VARA faces from its other near neighbors on the frequency pair. As these other machines add their own PL frequencies in the future, VARA will add anti-PLs to complement them as well.

A couple of notes here. First, as you may have guessed, it is possible for a control operator at WR9ABQ to switch the repeater to PL-only operation with a simple control code. That this is very seldom necessary is a tribute to the effectiveness of the mode of PL use described here. Second, the proper PL tone, when received by the repeater, is regenerated at the output frequency for use by the tone-activated squelches of the local control stations. This prevents them (assuming they have PL decoders) from having to hear the outputs of other machines on the frequency during band openings — more sanity insurance.

None of these ideas are new, of course. However, the combination of these ideas seems to be something new to amateur radio repeater systems, and it's about time we seriously considered using it. The reason is compelling. In these days of crowded repeater channels, "PL-loosening carrier squelch" plus "anti-PL" can create a far more livable situation on a repeater for everyone concerned, including the user with PL, the user without PL, the control operator, everyone at the next repeater (assuming they have a like system), and, ultimately, the state or regional repeater council.

The key to all these good things, on a major scale, lies not just with the local machine, but also in two other directions: 1) cooperation from the other neighboring machines on the frequency pair, either on a one-to-one basis or through the state or regional repeater council, and 2) cooperation from the majority of repeater users, particularly the well-equipped VHF FM operator.

For example, WR9ABQ has been able to work out a cooperative agreement with the WR9ADF machine in Bloomington, wherein each machine's access PL tone is the other's anti-PL. As mentioned earlier, VARA hopes that the other nearby repeaters on its frequency pair (at least) will follow suit sometime in the near future.

State and regional repeater councils can be of great assistance here by drawing up a plan of PL assignments to go along with their frequency pair assignments. One idea is to divide up a state or region into PL areas, with each area having its own PL frequency. All open repeaters in that area would utilize the same PL frequency in a PL carrier squelch loosener system, along with anti-PLs for all the surrounding areas. Users would need only one PL frequency determining element (reed or twin-T) to work any open local repeaters, while reaping the full benefits of repeater communication. Or, a user could skip PL entirely (say, for operation outside of his home area) without danger of being completely shut out of repeater operation, though with reduced benefits. This eliminates the need for a "universal" mobile PL on all repeaters, as at least one state repeater council has proposed.

With 32 PL frequencies, there are certainly more than enough to go around for any given region or state to allocate for all of their discreet areas, with enough left over for the private repeater crowd. I envision using, say, six to eight of these PL frequencies for this purpose, since common sense dictates that "checkerboarding" of areas can cut down on the number of anti-PL reeds (or whatever) needed by any given repeater. Coordination of PL frequencies within a state or region should not be a problem with competent administration at the council level.

While we're on the subject of quality administration, it must be noted here that a plan of this sort cannot and will not effectively replace the use of common sense in frequency coordination at the council level. The two cooperating repeaters referred to in this article are one hundred twenty miles apart. Had they been closer than, say, eighty miles, this plan simply would not have worked. Any coordinator is asking for trouble when he tries to use this system to shoehorn coordinations for co-channel machines into the same area. Basically, we're trying to solve problems that are already here, rather than find an excuse to create new ones.

Cooperation by the well-equipped fixed station and the high-power mobile station is also essential. VHF repeater users are generally divided into two groups: the low-budget, low-power guy with the rice-box class rig and not much else, and the sophisticated, high-power fixed station or mobile. The latter usually has a lot of money sunk into frequency synthesis, amplifiers (upwards of a hundred Watts worth), and a superb antenna system, often with hard line feed. Too often, however, the one thing that money did not buy is a way to turn the power down, usually in a mobile situation. And, let's face it, it's impossible to try to adjust your power up and down, while you're driving, to accommodate for constantly changing terrain conditions. It just can't be done. However, the use of the PL system which is described here can provide the kind of control needed to keep your signal accessing only the machine you wish to access.

Even turning the beam at the fixed station cannot insure that your signal will stay out of an unwanted place, because of the number of minor side lobes in any directional antenna pattern (there are 44 such lobes in the typical 22-element blockbuster). Again, the answer is the PL system described in this article.

The experiences of WR9ABQ and WR9ADF have shown that PL can be used on a repeater without shutting out the non-PL user. These experiences suggest that the same idea will work just about anywhere that moderate repeater crowding is a problem. What is now needed is a determined effort by repeater councils (or in lieu of that, between repeaters on the same frequency pair) to coordinate and by repeater users to utilize some sort of PL plan to make such a system fully effective. It is not hard to do, and the ultimate reward is a saner time for all on those crowded repeater channels.

My sincere thanks to Bob Swoger K9WVY for his inspiration and assistance in the preparation of this article. ■

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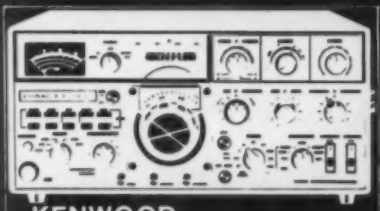

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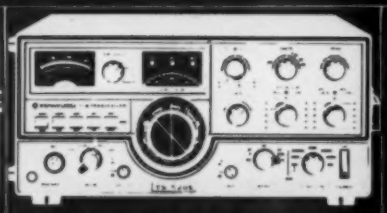

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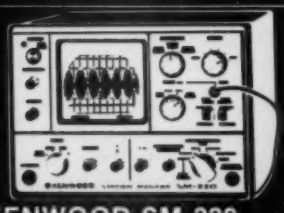

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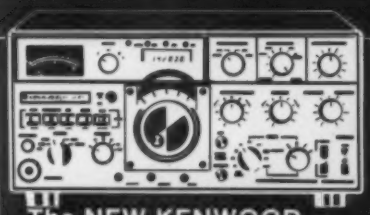

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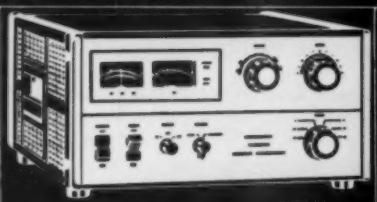

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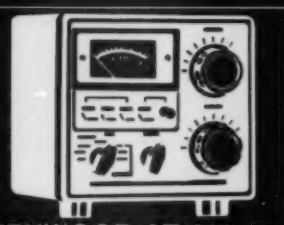

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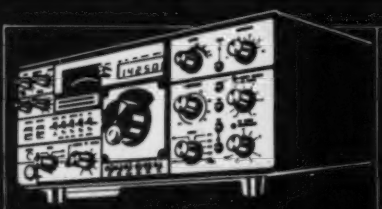
May We Suggest...

Yaesu – Call Toll Free

1-800-633-3410



YAESU FT-901 DM
HF transceiver

Check these: • Reject tuning • Variable IF band width tuning • Audio peak frequency tuning • Digital LED frequency display w/memory for TX & RX, no external VFO required for split frequency operation • Built-in Curtis keyer • Rugged GE 6146B final tubes • 160 thru 10 meter coverage & much more!

1299.00 list price. Call for quote

YAESU FT-7
HF transceiver

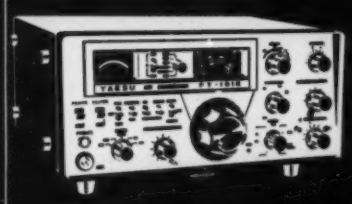
The NEW FT-7 features: • Frequency coverage 10 thru 80 meters • Sensitivity: 0.5 micro volts for S/N 20 dB • Emissions: LSB, USB, CW • Input power: 20 watts DC • Completely solid-state, single knob tune-up • X'tal calibrator built-in • Semi-break-in with sidetone • Receiver offset tuning • Extremely compact for installation under dashboard

499.00 list price. Call for quote

YAESU FT-227R
"MEMORIZER"

• One knob channel selection using optical sensing to select 800 channels • Memory circuit allows instant return to any frequency selected between 144-148 MHz • 4 digit LED frequency readout • Fully synthesized frequency control • Automatic final protection, PLL "unlock" protection circuit and busy channel indicator • Selectable 10 watt HI/1 watt LOW output

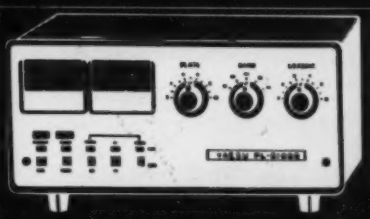
319.00 list price. Call for quote



YAESU
FT-101E transceiver

FT-101E is completely solid-state • Coverage: 160 thru 10 meters • Built-in AC/DC power supplies • Built-in RF speech processor • 260 watts PEP on SSB, 180 watts on CW, 80 watts on AM • Solid-state VFO • VOX • Auto break-in CW sidetone • WWV/JJY reception • Heater switch

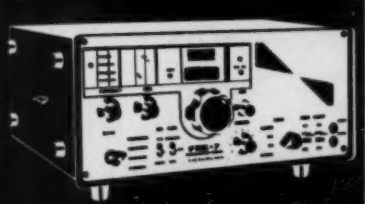
799.00 list price. Call for quote



YAESU FL-2100B
linear amplifier

The FL-2100B has: • 1200W PEP • Input on 80-10 meters • Easy primary voltage change: 117 to 234 VAC • Dual meters for plate current & voltage • Adjustable SWR meter • Individually tuned input coils on each band • Drive requirement: 30 to 100W

479.00 list price. Call for quote



YAESU FRG-7 receiver

FRG-7 features: Covers 4 bands, 0.5 to 29.9 MHz • SSB (selectable USB or LSB), AM, AM/ANL, CW • Exceptional sensitivity and stability from the Wadley Loop System • 3-position selectable RF attenuator • Auto noise suppression • AC, DC or internal battery power supply

283.50 list price. Call for quote.

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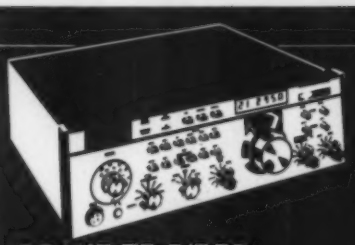


DRAKE TR-7/DR7
HF transceiver

NEW TR-7 is solid-state, continuous coverage and synthesized. TX or RX SSB, CW, RTTY, or AM independently. Noise blanker. Special high power solid-state PA. Internal test facilities: S-meter, RF wattmeter, VSWR bridge and digital freq. counter reads to 150 MHz for tests. RIT. Power: 250W PEP input. Frequency: 1.5 to 30 MHz.

1072.00 list price. Call for quote.

DRAKE MN-4C
matching network

New MN-4C features: 160 thru 10 meters coverage • Matches coax FED long wire, or balanced line antennas with optional 4:1 balun (24.95) • Handles 250 watts continuous RF output • Built-in RF watt meter, VSWR bridge • Unique "low-pass filter" design provides significant harmonic reduction to fight TVI.

165.00 list price. Call for quote.

DRAKE MS-4
matching speaker

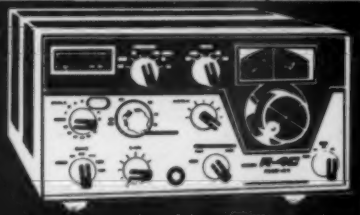
The MS-4 is designed for use with the Drake R-4C, R-4B, R-4A, & R-4 receivers. It has space inside for the Drake AC-4 power supply • The 8-ohm speaker will always come through loud and clear.

33.00 Call for yours today.

DRAKE
1525 EM
microphone

The auto-patch encoder and microphone are a single unit, fully wired and ready to use • High accuracy IC tone generator, no frequency adjustments • High reliability Digitran® keyboard • Power for tone encoder from transceiver via mic cable • Encoder audio level adjustable from 1mV to 5mV with internal potentiometer • Low output impedance • 4-pin plug.

49.95 Call for yours today.



DRAKE R-4C receiver

R-4C has same coverage as the T-4XC plus any 500 KHz range between 1.5 and 30 MHz • Also use for MARS, WWV, CB, Marine & Shortwave reception • Linear permeability-tuned VFO • 3 AGC release times • Crystal lattice filter in first IF prevents cross-modulation.

699.00 List Price. Call for quote.

DRAKE T-4XC transmitter

• Coverage: 80, 40, 20, 15m & 28.5 to 29.0 MHz of 10 meters • Covers 160 meter w/accessory crystal • Two 8-pole crystal lattice filters for SSB selection • Controlled carrier modulation for AM • Built-in VOX or PTT on SSB or AM • TX AGC prevents flat-topping • RTTY easy adaption, AFSK or FSK.

699.00 List price. Call for quote.

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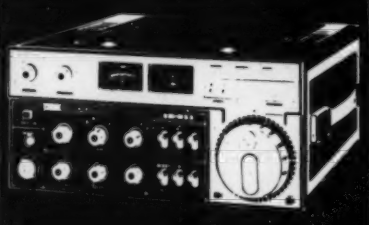
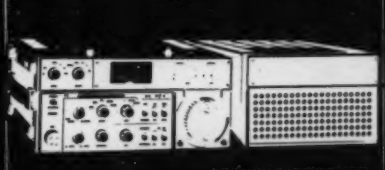


ICOM IC-211
2m transceiver

Features • 144 to 148 MHz coverage • Modes: SSB, CW, FM • LSI synthesizer PLL • 4-digit LED readout • Pulse-type noise blanker • VOX, antivox • Semi-break-in CW • Built-in SWR bridge • CW monitor and more!

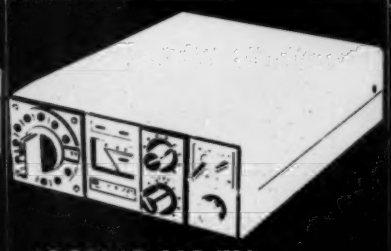
749.00 list price. Call for quote



ICOM IC-701
HF transceiver

The NEW IC-701 features • Solid-state • RF speech processor • 100 W continuous on all bands, all modes • USB, LSB, CW, CW-N, RTTY operation • Double balanced Schottky Diode Mixer used in both RX/TX • Dual built-in digital VFO • Price includes mic & power supply.

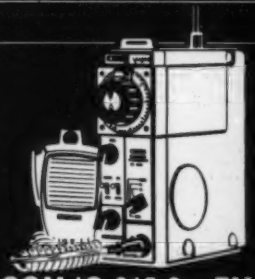
1495.00 list price. Call for quote



ICOM IC-22S FM
transceiver

• Frequency range: 146 to 148 MHz • Present any 15 KHz channel in the frequency synthesizer by diode matrix board • Output: 10 W HI, 1 W LOW • Excellent spurious attenuation • 22 channels

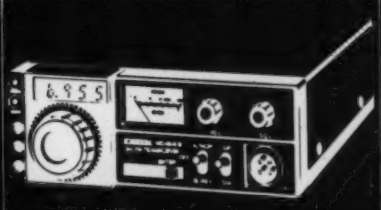
299.00 list price. Call for quote



ICOM IC-215 2m FM
transceiver

• 2 meter FM • 3W PEP • 15 channels: 12 by selector, 3 by function switch • Dual power level, 3W HI for long distance, 0.5W LOW for local • Dial illumination for night use • Power pilot lamp • Frequency range: 146 to 148 MHz

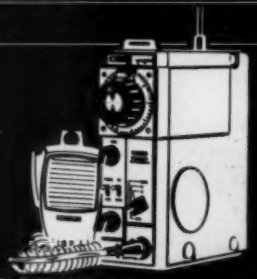
229.00 list price. Call for quote



ICOM IC-245
2m transceiver

The IC-245 features • LSI synthesizer PLL • 4-digit LED readout • TX & RX frequencies are independently programable on any separation • Receiver front-end is a balance of low noise, high-gain MOS-FET & 5 section filter • TX output: 10W PEP

499.00 list price. Call for quote



ICOM IC-502
6m SSB, CW portable

The 502 is a 6 meter SSB and CW portable with telescoping antenna & hand mic • Frequency coverage: 50 to 51 MHz • Modulation: A3J and A1 • RF output power: A3J: 3 watts PEP and A1: 3 watts • Sensitivity: 4 microvolts for 20 dB quieting • Virtually no intermod

249.00 list price. Call for quote

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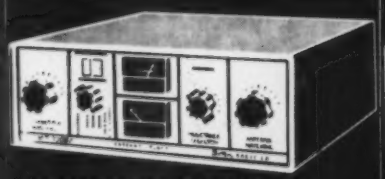
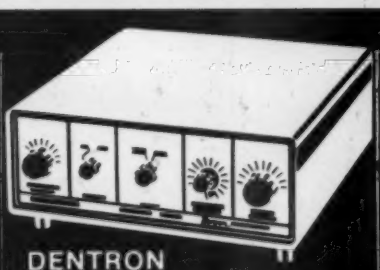


DENTRON MT-3000A antenna tuner

• 160 thru 10 meter coverage • Handles a full 3KW PEP • Continuous tuning 1.8-30 mc • Built-in dual watt meters • Built-in 50 ohm dummy load for proper exciter adjustment • Antenna selector switch enables you to by-pass the tuner direct or select the dummy load or 5 other antenna systems

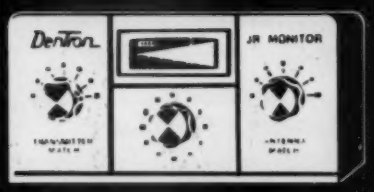
349.50 list price. Call for quote



DENTRON MT-2000A antenna tuner

An economical, full power tuner designed to handle virtually any type of antenna. Features: • Continuous tuning 1.8 to 30 MHz • Handles a full 3KW PEP • Front panel coax bypass switching • Built-in 3-core balun • Front panel grounding switch • Sleek styling to match other Dentron units

199.50 list price. Call for quote



DENTRON Jr. Monitor

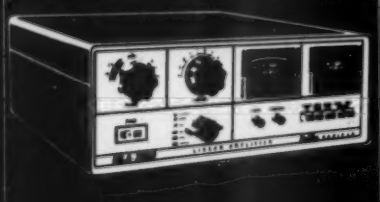
Call it what you will ... antenna tuner, transmatch, matchbox or matching network, the Jr. Monitor has it all wrapped up in one neat little cabinet • Continuous tuning 1.8 to 30 MHz • Forward reading relative output power meter • 300 watt power capability • Built-in env. ipsolated balun

79.50 Call for yours today

DENTRON 160-10AT super tuner

Balanced line, coax cable, random or long wire antennas, the 160-10AT will match it. 160 thru 10 meters • Continuous tuning 1.8-30 mc • 3 inputs • Handles 500 watts DC, 1000 watts PEP • Heavy duty 2-core Balun (3" dia. x 3" H) • Tapped inductor #12 ga wire

129.50 list price. Call for quote



DENTRON MLA-2500 linear amplifier

Features • 160 thru 10 meters • 2000 watts PEP input on SSB • 1000 watts DC input on CW, RTTY, SSTV • Self contained continuous duty power supply • Covers MARS w/o modification • 50 ohm input/output impedance

799.50 list price. Call for quote

DENTRON W-2 wattmeter

The W-2 lets you read forward and reflected watts at the same time • Forward watt scale: 2000 or 200 • Reflected watt scale: 200 watts • Low insertion loss • Frequency range: 1.8 to 30 MHz • Accuracy: 5% • Two 50-239 connectors • Sensor box may be extended 4 feet

89.55 Call for yours today

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MOSLEY TA-33
3-element tri-band beam

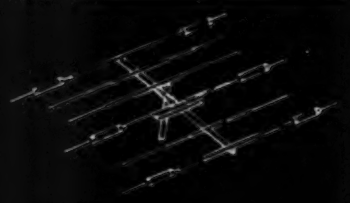
The TA-33 has 10.1 dB forward gain (over isotropic source) • Front-to-back ratio 20 dB • Power rating 2 KW PEP SSB input • Exceptional broadband — gives excellent results over full ham bandwidth • VSWR at Resonance 1.5:1 or better • Boom length 14' • Longest element 28' • Wind surface area 5.7 sq. ft.

206.50 list price. Call for quote.

MOSLEY CL-33
3-element beam

The CL-33 has 10.1 dB forward gain (over isotropic source) • Front-to-back ratio 20 dB • Power rating 2 KW PEP SSB input • VSWR at Resonance 1.5:1 or better • Boom length 18' • Longest element 27' • Wind surface area 6 sq. ft. • Patented Classic Feed System

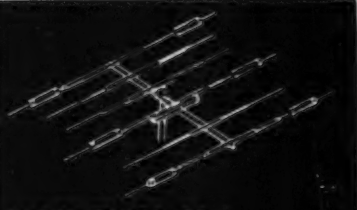
232.50 list price. Call for quote.



MOSLEY TA-36
6-element tri-band beam

The TA-36 features 10.1 dB forward gain (over isotropic source) • Front-to-back ratio 20 dB • Power rating 2 KW PEP SSB input • VSWR at Resonance 1.5:1 or better • Boom length 24' • Longest element 29' • Wind surface area 10.7 sq. ft. • 10, 15, 20 meters

335.25 list price. Call for quote.



MOSLEY CL-36
6-element tri-band beam

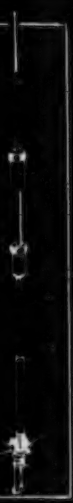
The CL-36 features 10.1 dB forward gain (over isotropic source) • Front-to-back ratio 20 dB • Power rating 2 KW PEP SSB input • VSWR at Resonance 1.5:1 or better • Boom length 24' • Longest element 29.9' • Wind surface area 10.7 sq. ft. • 10, 15, 20 meters • Patented Classic Feed System

310.65 list price. Call for quote.

MOSLEY CL-203
3-element 20m beam

The CL-203 has 10.1 dB forward gain (over isotropic source) • Front-to-back ratio 20 dB • Power rating 2 KW PEP SSB input • VSWR at Resonance 1.5:1 or better • Boom length 24' • Longest element 33' 8" • Wind surface area 6.8 sq. ft.

235.65 list price. Call for quote.



MOSLEY RV-4C
vertical antenna

The RV-4C self supporting vertical features • Power rating 2000 watts PEP SSB input • Feed Point Impedance 52 ohms • VSWR at Resonance 1.5:1 or better • Height 22' • Max radial length 34'7" • Wind surface area 2.049 sq. ft. • Covers 10, 15, 20 & 40 meters

63.35 Call for yours today.

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Road Runner Ranch
Box 73
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RAMmed By Morrow

—*ECONORAM III lauded*

It wasn't long after I put my ECONORAM II (ER II) memory board into service that I decided that 8K was just not enough RAM. I was about to order another ER II when I saw the ad for the ECONORAM III (ER III). For the same price ($188), Thinker Toys* was selling an assembled 8K dynamic RAM board. Since I had not had any experience with dynamic memory boards, I ordered one.

Imagine my surprise when I received not only my ER III, but also a check for thirty-nine dollars, because the price had been reduced to $149! Thinker Toys' ad states a kit price of $159, which means that you have to pay a premium of ten dollars if you wish to assemble it yourself. How's that for a switch? If it won't work with your S-100 computer, a complete refund is offered.

In comparing it to the ER II, I find that they both are configured in 4K blocks that can be addressed separately anyplace in memory. ER II has a software and hardware read-only feature, while ER III can be protected only with a built-in switch. The ER III has on-board refresh which is transparent to the CPU. This means that it looks like a static RAM board, as far as the processor is concerned.

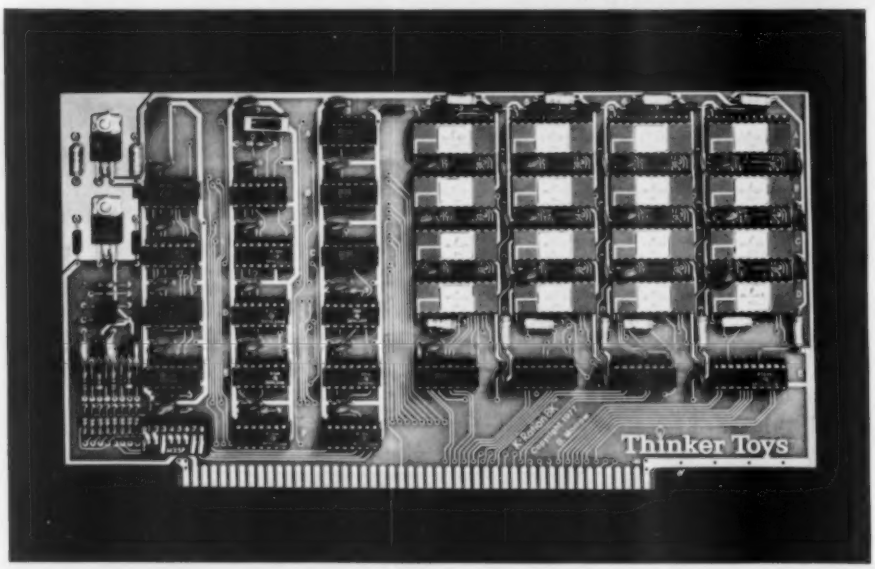
Whereas the ER II comes with a four-page instruction sheet, the ER III arrives with a twenty-six page manual. This manual has sections on theory, operation, memory diagnostic tests (in both hex and octal), parts, schematics, and assembly instructions. This last section seems superfluous. I can't quite see them selling too many kits.

Since ER III arrives completely assembled, all that is necessary to put it to work is to set the desired addresses on the switches and make sure that the read-write switch is placed on write. A long run of both my memory diagnostic test and theirs failed to indicate any problems, and none has shown up since.

Three advantages of dynamic RAM, as opposed to the static type, are higher bit density, lower power consumption, and lower cost per bit. I have used ER II and ER III interchangeably and have not noticed any differences between them. Apparently, neither has my processor.

ECONORAM II and ECONORAM III offer the memory buyer a choice of static or dynamic RAM and a very good value for his money. ■

*Thinker Toys, 1201 10th Street, Berkeley CA 94710.



ECONORAM III 8K dynamic memory board. 4K memory chips can be seen in the upper right corner of the board. Note the lack of heat sinks on the voltage regulators. The low current requirements of the board make them unnecessary. Designed by George Morrow.

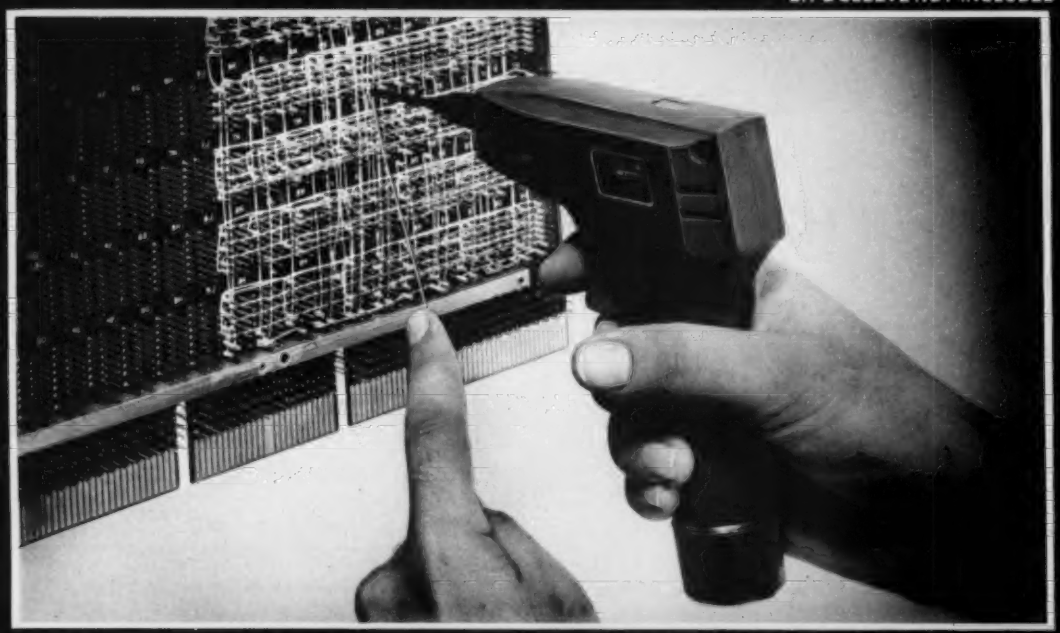
NEW!

"INDUSTRIAL" WIRE-WRAPPING TOOL

MODEL BW928

$49.95

BATTERIES NOT INCLUDED
BIT & SLEEVE NOT INCLUDED



- **BATTERY OPERATED**
  (2) Standard "C" Ni Cad Batteries (not included)
- **INTERCHANGEABLE BITS & SLEEVES**
  (not included)
- **REVERSIBLE ROTATION**
  For unwrapping, reverse batteries
- **BACKFORCE OPTIONAL**
  Model BW928-BF $52.95
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- **LIGHT WEIGHT**
  *LEXAN™ Housing

*LEXAN™ GENERAL ELECTRIC

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```
A048  0100                          Set program counter
0100  CE  0200                      LDX message pointer
0103  A6  00                        LDA A  O,X
0105  81  04                        CMP A  EOT
0107  26  06                        BNE
0109  7F  A049                      CLR
010C  7E  E0E3                      JMP  to control
010F  BD  E1D1                      JSR  OUTEEE
0112  08                            INX
0113  20  EE                        BRA
0200  48  45  4C  4C  4F            HELLO
0205  20                            Space
0206  49                            I
0207  20                            Space
0208  41  4D                        AM
020A  20                            Space
020B  41                            A
020C  20                            Space
020D  53  57  54  50  43            SWTPC
0212  20                            Space
0213  36  38  30  30                6800
0217  20                            Space
0218  43  4F  4D  50  55  54  45  52 COMPUTER
0220  21                            !
0221  04                            EOT
```

Fig. 1. Program listing.

The big moment is at hand. Your 6800-based microprocessor from Southwest Technical is finally assembled. You've sprung for the MP-68 computer and the CT-64 terminal with monitor. You are all set! You have convinced yourself you'll be satisfied with machine language for a long time or at least until your BASIC arrives.

Well, surprise! After running diagnostic programs through the memory ten different ways, it still hasn't done or said anything. Even tic-tac-toe is an anticlimax when it takes two hours to be typed in by hand.

This short machine-language program allows you to print out a short message on your monitor. To place a message in the computer, you must refer to the ASCII hexadecimal chart supplied with your documentation notebook. This is necessary to translate your message in English into the ASCII code. Just to be sure that you get the idea, I will provide you with an example. The program will print the message, "HELLO I AM A SWTPC 6800 COMPUTER!" The message can be as long as you wish – just be sure to terminate it with 04. This tells the computer the message is over.

The program instructions are found in memory locations 0100 through 0114. The actual message is found between locations 0200 and 0221.

Now it does do something! Now you have just begun . . . ■

Charles E. Thomas WA3MWM
7022 Blackhawk
Pittsburgh PA 15218

```
*G HELLO I AM A SWTPC 6800 COMPUTER!
*
```

Fig. 2. Sample run.

Six Said His First Word Today!

—and you taught him how

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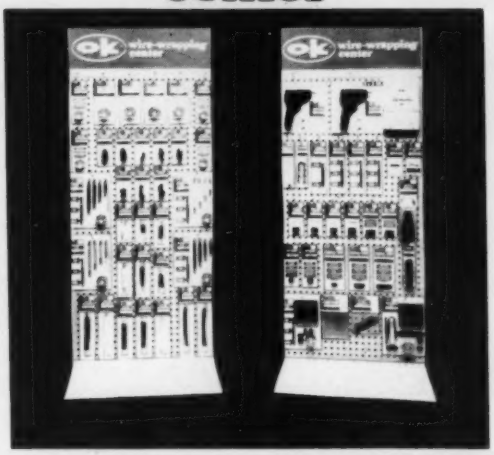
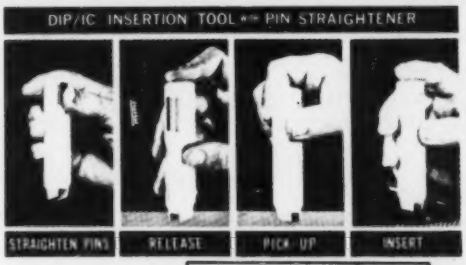
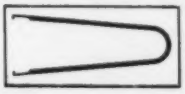


for quality electronic parts and tools.



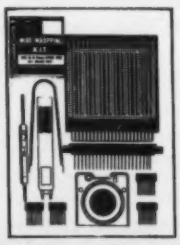
14-16 Pin Dip IC Inserter	INS-1416



DIP/IC EXTRACTOR TOOL

The EX-1 Extractor is ideally suited for hobbyist or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.

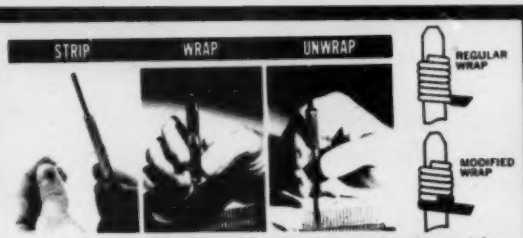
Extractor Tool	EX-1



WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1

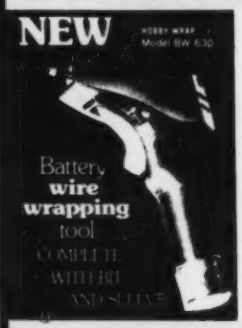
Wire-Wrapping Kit	WK-4B (Blue)



HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30
Modified Wrap	WSU-30M



WIRE-WRAPPING TOOL

For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630
For AWG 26-28	BW-2628

Bit for AWG 30	BT-30
Bit for AWG 26-28	BT-2628

*USE "C" SIZE NI-CAD BATTERIES (NOT INCLUDED)

ROLLS OF WIRE

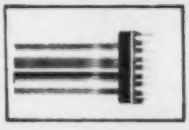
Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30 AWG Blue Wire, 50ft. Roll	R 30B-0050
30 AWG Yellow Wire 50ft. Roll	R 30Y-0050
30 AWG White Wire, 50ft. Roll	R 30W-0050
30 AWG Red Wire, 50ft. Roll	R 30R-0050

WIRE DISPENSER

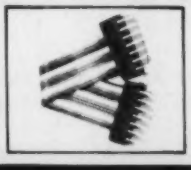
- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable (For refills, see above)

Blue Wire	WD-30-B
Yellow Wire	WD-30-Y
White Wire	WD-30-W
Red Wire	WD-30-R



RIBBON CABLE ASSEMBLY SINGLE ENDED

With 14 Pin Dip Plug 24" Long (609mm)	SE14-24
With 16 Pin Dip Plug 24" Long (609mm)	SE16-24



RIBBON CABLE ASSEMBLY DOUBLE ENDED

With 14 Pin Dip Plug - 2" Long	DE 14-2
With 14 Pin Dip Plug - 4" Long	DE 14-4
With 14 Pin Dip Plug - 8" Long	DE 14-8
With 16 Pin Dip Plug - 2" Long	DE 16-2
With 16 Pin Dip Plug - 4" Long	DE 16-4
With 16 Pin Dip Plug - 8" Long	DE 16-8

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Dave Lien W6OVP
8662 Dent Dr.
San Diego CA 92119

Dave Waterman K6MAR
834 Oak Lee Ln.
Alpine CA 92001

The 22S Programmer Program

—diode selection in BASIC

Here's a sure way to make a hit on your local two meter repeater. All you need add is a visiting Icom 22S owner without a diode matrix chart or a new owner anxious to program his new rice box. It beats trying to read the small print on the chart found in your instruction manual. Simply load this program into your TRS-80 microcomputer, and, as fast as the frequencies are entered, the exact diode placement for the matrix board is graphically drawn on the screen.

This program displays a drawing of the matrix board just as it exists in the IC-22S and then adds the diodes to the correct slots as you feed in the channel numbers and desired frequencies. It incorporates both math functions and graphics statements along with printed user instructions, yet only occupies about 2800 bytes of memory.

In Table 1 is a list of space-saving "Radio Shack shorthand" abbreviations used in this program.

Enough error messages have been inserted to keep you out of most jams you're likely to create as a result of this excitement. For instance, the program will not accept a request for more than 22 channels. It will only program frequencies from 146.01 MHz to 147.99 MHz, and it will not accept frequencies which do not meet the 15 kHz separation required by the IC-22S synthesizer. It also will not allow you to program the same channel twice during the same run.

F.	= FOR
G.	= GOTO
GOS.	= GOSUB
IN.	= INPUT
N.	= NEXT
P.	= PRINT
RET.	= RETURN
S.	= SET/STEP
T.	= THEN

Table 1.

Another feature of this program is automatic listing of each channel number on the matrix board display when you request programming of all 22 channels at one sitting. (You might as well let your computer handle this menial task.) If you choose to program fewer than 22 channels, then you are allowed to select the channel numbers at random. It will also display the frequency to the right of each channel row so you can refer back to a previously programmed channel.

The matrix board is split into two sections by the program. The first section (Fig. 1) shows the first 13 channels (about all you would want to program anyway), and the second section (Fig. 2) shows the remaining 9 channels. Don't worry about having to look through each of the first 13 channels to get to the last section; if you ask to program a channel between 14 and 22, it skips right into that section.

For the Computer Shrink

Analyzing the program, you can see that instructions have been compacted to conserve memory.

Lines 30 through 70 establish the number of channels to be programmed and verify that the number selected is compatible with the IC-22S capability. If all 22 channels are selected in one shot, line 50 jumps ahead to line 100 to eliminate nonpertinent instructions.

Line 150 initializes the values of J and U for later use. The FOR-NEXT loop at line 160 is the beginning of each successive programming run and only allows as many channels to be run as you initially entered as the channel number "P". If the condition at line 170 is not met (22 channels were requested to be programmed), then lines 180 and 190 take on the task of numbering each channel for you.

Line 200 is the error message which is called up when one of the conditions of line 223 is met. The FOR-NEXT loop in line 210 provides about 6 seconds delay to view this message.

Lines 220 and 223 establish the next channel number to be programmed. Line 225 checks to see if the channel you selected has already been programmed.

The A(1) to A(22) variables were initialized to zero back in line 52 (more about this later). If the condition of line 225 is not met, then line 226 prints the error message, and lines 227 through 229 allow you to select the next course of action. Line 229 erases the first part of the line which was printed by lines 226 and 227 before again writing the instructions at line 220.

Line 230 is an error message called up when one of the conditions of line 260 is met. Line 240 is another FOR-NEXT delay loop followed by J=J-1 which allows the same channel number to be displayed on the rerun. Line 250 establishes the next frequency to be programmed, which is checked by line 260.

Line 263 calls up the subroutine at 500 which checks the frequency selected to see if it is an increment of 15 kHz. If the frequency does not meet this requirement, an error message is displayed by line 510 and variable X is initialized to the value of 1. If line 263 finds X to be the value of 1 (it would normally be at the value of 3000 where it was last set by line 240), then the program again jumps back to line 240.

As the remark in line 265 states, lines 270 and 280 are used to determine if the first section of the board, containing channels 1 through 13, is to be displayed, or the second section, containing channels 14 through 22. Line 290 checks to see if the required section of board has already been printed. If the correct section has not been displayed (condition of line 290 has not been met), then line 300 will call up the subroutine at 600 to print it.

Lines 310 through 460 use the formula found inside of the IC-22S case. When any of the conditions are met to cause a diode to be placed on the board, a value for the

variable H is established which is used in the subroutine at 700 to print the diode at x-coordinate. In other words, "H" puts the diode in the correct column.

Line 470 is used to print the frequency in units of ones, tenths, hundredths, and thousandths of MHz. Line 470 protects against false answers showing up due to the subtraction process. You will find this procedure used throughout the program to keep it error free.

The value of variable W in line 470 is taken from line 730, which establishes the correct row to print the diode. Line 475 completes the FOR-NEXT loop initiated at line 160. When this FOR-NEXT loop has been completed, lines 480 through 490 allow the option of returning to line 20 and starting over or jumping ahead to a "locking loop" in line 999 to freeze the now completed diode display.

Conclusion

This program makes your TRS-80 computer an even more useful companion in the ham shack. Not only will you use it for the initial programming of your IC-22S, but also for changing existing channels. No longer will you have to search through the diode matrix chart to see if a frequency is IC-22S compatible or if it uses up your last remaining diodes.

Another advantage of using this program is its ability to display the diode matrix board with the diodes in place, before you actually solder them in. It's far easier to change diodes on the computer display than on the matrix board. ■

Fig. 1. Program listing.

```
10 REM IC-22S PROGRAMMED BY D.J. WATERMAN K6MAR 9/23/77
15 REM-COPYRIGHT (C) 1977 BY D.A. LIEN. ALL RIGHTS RESERVED.
20 CLS:P.TAB(14);" ** IC-22S MATRIX PROGRAMMER **"
30 P.:P.:IN." HOW MANY CHANNELS DO YOU WISH TO PROGRAM" ;P
40 IF(P<1)+(P>22)T.60
50 IF P=22T.100-
52 F.N=1TO22:A(N)=0:N.N
55 G.80
60 P.:P." USE CHANNEL NUMBERS 1 THRU 22 ONLY."
65 F.X=1TO1000:N.X
70 G.30
80 CLS:P." TYPE_THE CHANNEL NUMBER TO BE PROGRAMMED,"
90 P." AND THEN THE FREQUENCY YOU WANT AT THAT CHANNEL." ;G.110
100 CLS:P." TYPE THE FREQUENCY YOU WANT AT THE LISTED CHANNEL."
110 P.:P." NOTE. . YOU MUST ALWAYS TYPE THE LOWEST FREQUENCY"
120 P." OF THE DUPLEX PAIR, WHETHER IT IS A NORMAL"
130 IN." OR REVERSE SPLIT. PRESS ENTER WHEN READY" ;A$
150 CLS:J=0:U=0
160 F.S=1TOP
170 IF P<>22 T.220
180 J=J+1:C=J
190 P.AT(9);" CHANNEL" ;J;G.250
200 P.AT(9);" THE IC-22S ONLY HAS 22 CHANNELS,TRY AGAIN."
210 F.X=1TO 3000:N.X
220 P.AT(19);"  " ;P.AT(9);" CHANNEL #" ;
223 IN.C:IF (C<1)+(C>22)T.200
225 IF A(C)=0T.250
226 P.AT(0);" CHAN" ;C;" OCCUPIED." ;
227 P." EITHER 1-START OVER OR 2-SELECT A NEW CHAN" ;
228 IN.N:IFN=1T.20
229 P.AT(0);"                " ;:G.220
230 P.AT(9);" USE A FREQUENCY BETWEEN 146.01 AND 147.99 MHZ."
240 F.X=1TO 3000:N.X:J=J-1:G.170
250 P.AT(34);"FREQUENCY " ;:IN.F
260 IF(F<146.01)+(F>147.99)T.230
263 GOS.500:IFX=1T.240
265 REM T=1 PRINTS BOARD WITH CH 1-13,T=2 PRINTS CH 14-22
270 A(C)=C:IF C<14 T.T=1
280 IF C>13 T.T=2
290 IF T=U T.310
300 GOS.600
305 REM THIS SECTION DETERMINES DIODE PLACEMENT
310 G=(F-144.39)/.015:IF G<128T.330
320 H=0:GOS.700:G=INT(G-128+.1)
330 IF G<64T.350
340 H=14:GOS.700:G=INT(G-64+.1)
350 IF G<32T.370
360 H=28:GOS.700:G=INT(G-32+.1)
370 IF G<16T.390
380 H=42:GOS.700:G=INT(G-16+.1)
390 IF G<8T.410
400 H=56:GOS.700:G=INT(G-8+.1)
410 IF G<4T.430
420 H=70:GOS.700:G=INT(G-4+.1)
430 IF G<2T.450
440 H=84:GOS.700:G=INT(G-2+.1)
450 IF G<1T.470
460 H=98:GOS.700
470 X=INT((F-140)*1000+1)/1000:P.AT(64*(W-1)/3+36);X
475 N.S
480 P.AT(961);" DO YOU WANT TO PROGRAM ADDITIONAL CHANNELS" ;
485 P." (YES/NO)" ;
490 Y=1:N=2:IN.X:ON X G.20,999
500 X=F/.015:Y=INT(X+.5):X=(X-Y)*100+.1:Y=INT(X):IFY=0T.RET.
510 P.AT(9);F;" IS AN INVALID FREQUENCY." ;X=1:RET.
600 REM THIS SUBROUTINE PRINTS MATRIX BOARD
605 IF T=1T.620
610 A=23:Y=14:G.630
620 A=14:Y=1
630 U=T:P.Y;
640 F.X=4TO47 S.7:P.TAB(X);" . ." ;:N.X
650 P.TAB(53);" . ." ;Y=Y+1:IFY=A T.670
660 G.630
670 P.TAB(4);" D7" ;TAB(11);" D6" ;TAB(18);" D5" ;TAB(25);" D4" ;
680 P.TAB(32);" D3" ;TAB(39);" D2" ;TAB(46);" D1" ;TAB(53);" D0"
682 IF T=1 T.690
685 P.:P.:P.:P.
690 RET.
695 REM THIS SUBROUTINE PRINTS DIODES IN GRAPHICS MODE
700 IF T=1 T.730
710 IF C<14 T.730
720 C=C-13
730 W=1+C*3
735 F.X=8+HTO13+H:S.(X,W):N.X
740 RET.
999 G.999
```

Gordon W. Flemming WA6VIY
13490 Simshaw Avenue
Sylmar CA 91342

The Occult Computer

—test for ESP with a micro

As you can see from the absence of schematics or block diagrams, this is not a construction article. Many articles have appeared in hobbyist and professional computer magazines regarding interfacing to and from microcomputers. You can find data about communicating with a keyboard, a printer, a cassette recorder, and many other devices including your TV.

A big difference with the interface described here is that no additional hardware will need to be built. The interface is bidirectional, using the same "terminal" for input and output, and you already have the terminal. The data transfer rate is instantaneous.

The terminal is the most complicated data-processing device in existence — your

```
LIST

10 REM PROGRAM TO EVALUATE ESP
15 REM WRITTEN BY G.W.FLEMMING
20 REM 18 MAY 1977
25 CLEAR 100
30 DIM D$(25),C$(25)
40 Z=0:T=0
50 PRINT"   THIS PROGRAM IS USED TO EVALUATE THE POSSIBILITY"
55 PRINT"OF ESP ( EXTRA-SENSORY PERCEPTION ) IN AN"
60 PRINT"INDIVIDUAL. THE TEST IS PATTERNED AFTER TESTS"
65 PRINT"BEING RUN IN PARAPSYCHOLOGY LABORATORIES."
70 PRINT
80 INPUT"NAME OF PERSON DOING TEST";N$
90 PRINT"DO YOU WANT TO GUESS BEFORE OR AFTER THE"
95 INPUT"COMPUTER SETS-UP THE DECK (BEFORE OR AFTER)";A$
110 IF LEFT$(A$,1)="A" THEN GOSUB 500
113 PRINT
120 PRINT"YOUR GUESSES (+ - = $ #):"
125 PRINT"  ....I....I....I....I....I"
130 INPUT G$
135 GOTO 1100
140 IF LEFT$(A$,1)<>"A" THEN GOSUB 500
200 REM COMPARISON ROUTINE
210 N=0
220 FOR I=1 TO 25
230 IF MID$(G$,I,1)=D$(I) THEN N=N+1
240 NEXT I
300 REM OUTPUT RESULTS
310 PRINT:PRINT"RESULTS:"
320 PRINT"MY DECK:   ";
330 FOR I=1 TO 25
340 PRINTD$(I);
350 NEXT I
360 PRINT
370 PRINT"YOUR GUESS:";G$
375 GOSUB 999
380 PRINT"YOU HAD";N;"CORRECT, WHICH IS";N/25*100;"%."
400 Z=Z+N:T=T+1
450 INPUT"ANOTHER TRY (Y OR N)";T$
460 IF LEFT$(T$,1)="Y" THEN 110
465 PRINT:PRINT
470 PRINT"THE RESULTS FOR ALL OF THE TRIES FOR ";N$
475 PRINT"ARE ";Z;"CORRECT OUT OF";T*25;"CARDS."
480 PRINT"THIS IS AN AVERAGE OF";Z/T/25*100;"%."
485 PRINT"REMEMBER, CHANCE WOULD BE 20%."
486 PRINT"TRY AGAIN SOME TIME....."
487 PRINT:PRINT:PRINT
490 END
500 REM ROUTINE TO CREATE A 25 CARD DECK
510 REM FIRST FILL DECK WITH LETTER A'S
515 FOR I=1 TO 25
520 D$(I)="A"
525 NEXT I
530 REM PLACE 5 +'S AT RANDOM IN DECK
535 FOR Q=1 TO 5
540 R=INT(25*RND(8))+1
550 IF D$(R)<>"A" THEN 540
560 D$(R)="+"
570 NEXT Q
600 REM PLACE 5 -'S AT RANDOM IN DECK
610 FOR Q=1 TO 5
620 R=INT(25*RND(8))+1
630 IF D$(R)<>"A" THEN 620
640 D$(R)="-"
650 NEXT Q
700 REM PLACE 5 ='S AT RANDOM IN DECK
710 FOR Q= 1TO5
720 R=INT(25*RND(8))+1
730 IF D$(R)<>"A" THEN 720
740 D$(R)="="
750 NEXT Q
800 REM PLACE 5 $'S AT RANDOM IN DECK
810 FOR Q= 1TO5
820 R=INT(25*RND(8))+1
830 IF D$(R)<>"A" THEN 820
840 D$(R)="$"
850 NEXT Q
900 REM FILL REMAINING CARDS AS #'S
910 FOR Q=1 TO 25
920 IF D$(Q)="A" THEN D$(Q)="#"
930 NEXT Q
940 REM RETURN TO PROGRAM WITH 25 CARD DECK
950 RETURN
999 REM ROUTINE FOR ADDING * TO MARK CORRECT MATCHES
1000 FOR I=1 TO 25
1001 C$(I)=" "
1002 NEXT I
1005 FOR I=1 TO 25
1010 IF D$(I)=MID$(G$,I,1) THEN C$(I)="*"
1020 NEXT I
1030 PRINT"RIGHT......";
1040 FOR I=1 TO 25
1050 PRINTC$(I);
1060 NEXT I
1070 PRINT
1080 RETURN
1100 REM ERROR ROUTINE FOR INPUT
1110 IF LEN(G$)<25 THEN 1150
1120 IF LEN(G$)>25 THEN 1180
1130 GOTO 140
1150 PRINT"YOU DID NOT ENTER ENOUGH CHARACTERS...TRY AGAIN."
1155 GOTO 120
1180 PRINT"YOU PUT IN TOO MANY CHARACTERS. ONLY THE FIRST"
1185 PRINT"25 WILL COUNT."
1190 GOTO 140
Ok
```

Fig. 1. Program listing.

mind. People have dreamed for years of mental telepathy, reading someone's mind. Many have tried psychokinesis, controlling an object with the mind. (Haven't you tried to make a pair of dice come up with your number?)

In addition to those of us who are casually interested or amazed by such actions, many learned people have spent years scientifically investigating the phenomena. Foremost among these people is Dr. J. B. Rhine, who headed the parapsychology lab at Duke University for years. A check at your local public library should produce several of his books which are written for the layman.

These investigators have test data that show statistically that mental telepathy does exist. But, when it comes to suggesting why and how, your opinion is as valid as their ideas.

One laboratory test consists of trying to write down the correct order of cards in a well-shuffled deck. The cards are not the normal playing type, but consist of a deck of five each of five different symbols. Thus, a 25-card deck is used for testing. The law of averages says that a person should get five of the 25 cards correct.

The program described here will enable you to gather test data and form your own opinion about ESP (extrasensory perception). Run the test on yourself, your relatives, and friends. You will soon find that some people get consistently good results, and some people get consistently nominal results. (I'm one of the nominal types.)

This program simulates the random shuffling of the laboratory-type deck of cards. Some of the safeguards needed in the lab are not required. How can you visually peek at a memory word? There is no requirement for a person to look at the cards and mentally send the information to you. By the way, some people are good senders, and some people are good receivers. Check each person both ways.

Now let's look at the program. The REM statements should explain the operations, but the impact of some of the decisions on the test is not apparent. If you choose to have the computer set up the deck first, then the test is a test for telepathy — that is, you are trying to read the memory contents.

However, if you choose to go first, the test becomes one for psychokinesis — that is, you are trying to control the contents of the computer deck in the memory, not read it.

Program lines 500 through 950 create the computer deck by randomly placing the five cards of each symbol. The symbols were chosen to be as different as possible and to all be typed with the shift key pressed to make it simpler for persons not familiar with the keyboard.

You might want to experiment with a different set of symbols. You may find that you can "read" some symbols better than others. Keep a record to see if you are better able to "read" a particular symbol.

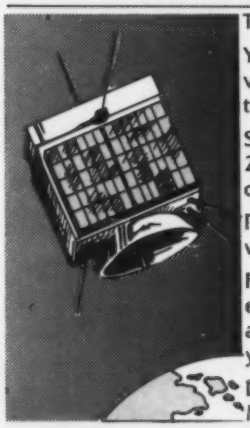
Program lines 999 through 1080 were added after running the main program a few times. Line 375 was added to access this routine. You might want to add a subroutine to keep a running total of the number correct for each of the symbols. You could modify the program to allow the person being tested to select his own five symbols.

You can either treat the program as a game or a research tool. You may start running the program as a game, but when results tend to be much better than average, you will begin to question what is happening.

Above all, have fun. ■

```
RUN
    THIS PROGRAM IS USED TO EVALUATE THE POSSIBILITY
OF ESP ( EXTRA-SENSORY PERCEPTION ) IN AN
INDIVIDUAL. THE TEST IS PATTERNED AFTER TESTS
BEING RUN IN PARAPSYCHOLOGY LABORATORIES.

NAME OF PERSON DOING TEST? LLOYD
DO YOU WANT TO GUESS BEFORE OR AFTER THE
COMPUTER SETS-UP THE DECK (BEFORE OR AFTER)? BEFORE

YOUR GUESSES (* + = $ #):
  ....I....I....I....I....I
? ==+++++$$#+#$==$$#++++++=

RESULTS:
MY DECK:   $==+#$+++##+==$$+==#=+#$++
YOUR GUESS:==++++$$#+#$=+$$#++++++=
RIGHT.....      '    '    '    '
YOU HAD 4 CORRECT, WHICH IS 16 %.
ANOTHER TRY (Y OR N)? Y

YOUR GUESSES (* + = $ #):
  ....I....I....I....I....I
? +=++==#$#$++==++#$#$#$
YOU DID NOT ENTER ENOUGH CHARACTERS...TRY AGAIN.
YOUR GUESSES (* + = $ #):
  ....I....I....I....I....I
? ==++++$$##++++=+$##$====+$

RESULTS:
MY DECK:   #$=#$===+$=#+$=#++++++$+#
YOUR GUESS:==++++$$##++++=+$##$==+#$
RIGHT.....          '          '
YOU HAD 2 CORRECT, WHICH IS 8 %.
ANOTHER TRY (Y OR N)? Y

YOUR GUESSES (* + = $ #):
  ....I....I....I....I....I
? ==++$$##++++$=##++$##+#$

RESULTS:
MY DECK:   =+++#=$=+#=$+++#+++$$$=#+#
YOUR GUESS:==++$$##++++$=##++$##+#$
RIGHT.....'    '    ' ' '         '
YOU HAD 6 CORRECT, WHICH IS 24 %.
ANOTHER TRY (Y OR N)? N


THE RESULTS FOR ALL OF THE TRIES FOR LLOYD
ARE  12 CORRECT OUT OF 75 CARDS.
THIS IS AN AVERAGE OF 16 %.
REMEMBER, CHANCE WOULD BE 20%.
TRY AGAIN SOME TIME.....
```

Fig. 2. Sample run.



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A Baudot Program For Your Micro

—simulated Vegas visit

Anyone who has ever been to Las Vegas is familiar with one of the most fiendish machines known to the mind of man. This ubiquitous device, designed to separate the victim from his change, is the slot machine, alias the "one-armed bandit."

The slot machine is everywhere — casinos, motels, banks, restaurants, even (rumor has it) pay toilets. They are designed to accept coins of all denominations except pennies.

Since casino gambling has been approved by the New Jersey legislature, it will no longer be necessary for us east coast people to travel to Las Vegas to dispose of our spare cash.

However, with this program, it is possible to enjoy the thrill of victory and the agony of defeat at the hands of an inanimate object without the normally attendant cash flow problems. The money saved by using this program could easily pay for another peripheral for your computer.

I got the idea for this program when I was browsing through a paperback book entitled *Gambler's Digest*. The Wang 2200 minicomputer which I have been using had several gambling game programs on a diskette, but the one for the slot machine had some kind of bug in it which made it inaccessible (at least to me) on the floppy. I had been toying with the idea (no pun intended) of programming the Wang to simulate a slot machine, but I wanted it to be realistic. I needed a list of relative probabilities for cherry, orange, bell, etc., and the normal payoffs. I found them in the *Gambler's Digest*.

There are many different slot machine configurations. The one I used is typical of many. It has three reels, and each reel has twenty symbols. This leads to 20 x 20 x 20 = 8,000 possible combinations. A jackpot is three bars. Since the bar appears once on the first reel, three times on the second reel, and once on the third reel, there are 1 x 3 x 1 = 3 possible ways to hit the jackpot in 8,000 combinations. To get some idea of the house odds, consider the winning combinations and their payoffs as shown in Table 1. For each 8,000 dollars that go into the slot, only $5,957 are returned as

Fig. 1. Program listing.

```
10 REM*******SLOT MACHINE********

20 REM PROGRAM WRITTEN BY VICTOR R. FRICKE

30 REM BASED ON LAS VEGAS ODDS AND PAYOFFS

40 REM DATA FOR REELS 1,2,AND 3

50 REM 1=BELL, 2=CHERRY, 3=LEMON, 4=BAR, 5=ORANGE,
   6=PLUM

60 DATA 2,6,3,2,6,5,2,3,6,2,4,2,6,5,2,3,6,2,5,1

70 DATA 2,4,5,2,1,5,2,4,5,2,1,2,5,4,2,1,5,2,6,5

80 DATA 5,6,1,5,3,6,5,3,1,5,6,4,5,3,5,6,1,5,6,3

90 DIM S$(6)8,R(3,20),X$8,Y$8,Z$8

100 X1=700:A=1:B=1:C=1

110 D=100

120 REM SET UP LIST OF SYMBOLS

130 S$(1)="**BELL**":S$(2)="*CHERRY*":S$(3)="*LEMON**"

140 S$(4)="**BAR***":S$(5)="*ORANGE*":S$(6)="**PLUM**"

150 REM INITIALIZE REELS

160 FOR I=1 TO 3:FOR J=1 TO 20:READ R(I,J):NEXT
    J:NEXT I

170 REM INSTRUCTIONS

180 PRINT HEX(03):PRINT "I AM THE COMPUTER SLOT
    MACHINE."

190 FOR I=1 TO X1:NEXT I

200 PRINT :PRINT "I AM DIRECTLY CONNECTED TO THE
    PAYROLL COMPUTER."

210 FOR I=1 TO X1:NEXT I

220 PRINT :PRINT "WIN, AND I WILL PAY YOU HANDSOMELY."

230 FOR I=1 TO X1:NEXT I

240 PRINT :PRINT "LOSE, AND I SHOW NO MERCY."

250 FOR I=1 TO X1:NEXT I

260 PRINT HEX(03):PRINT "YOU ARE STARTING WITH A
    STAKE OF $100."
```

```
270 PRINT "TO START THE GAME, PRESS 'EXECUTE'.
    EACH TIME YOU"

280 PRINT  PRESS 'EXECUTE', YOU ARE FEEDING ME A
    DOLLAR AND"

290 PRINT  PULLING MY ONE-ARM"

300 INPUT A$

310 REM ROLL THE REELS

320 PRINT HEX(03):PRINT TAB(19);"==============
    ==========="

330 R1=INT(RND(1)*35):R2=INT(RND(1)*35)+R1:R3=
    INT(RND(1)*35)+R2:I=1

340 IF I>R1 THEN 370

350 GOSUB 840

360 A=A+1:B=B+1:C=C+1:GOTO 430

370 IF I>R2 THEN 400

380 GOSUB 840

390 B=B+1:C=C+1:GOTO 430

400 IF I>R3 THEN 490

410 GOSUB 840

420 C=C+1

430 I=I+1

440 IF A<21 THEN 450:A=1

450 IF B<21 THEN 460:B=1

460 IF C<21 THEN 470:C=1

470 GOTO 340

480 REM CALCULATE PAYOFFS

490 X$=S$(R(1,A)):Y$=S$(R(2,B)):IF C<>1THEN
    500:C=21

500 C=C-1:Z$=S$(R(3,C))

510 IF X$<>"**BAR***"THEN 550

520 IF Y$<>"**BAR***"THEN 550

530 IF Z$<>"**BAR***"THEN 550

540 D=D+85:GOTO 780

550 IF X$<>"**BELL**"THEN 600

560 IF Y$<>"**BELL**"THEN 600

570 IF Z$<>"**BELL**"THEN 590

580 D=D+18:GOTO 780

590 IF Z$="**BAR***"THEN 580

600 IF X$<>"**PLUM**"THEN 650

610 IF Y$<>"**PLUM**"THEN 650

620 IF Z$<>"**PLUM**"THEN 640

630 D=D+14:GOTO 780

640 IF Z$="**BAR***"THEN 630

650 IF X$<>"*ORANGE*"THEN 700

660 IF Y$<>"*ORANGE*"THEN 700

670 IF Z$<>"*ORANGE*"THEN 690

680 D=D+10:GOTO 780

690 IF Z$="**BAR***"THEN 680

700 IF X$<>"*CHERRY*"THEN 770

710 IF Y$<>"*CHERRY*"THEN 770

720 IF Z$<>"*LEMON**"THEN 740

730 D=D+5:GOTO 780

740 IF Z$="**BELL**"THEN 730

750 D=D+3:GOTO 780

760 REM PRINT RESULTS

770 D=D-1

780 IF D<200 THEN 800

790 PRINT "MY COIN TRAY IS FULL. PLEASE PUT SOME
    COINS IN YOUR POCKET.":GOTO 820

800 IF D>10 THEN 820

810 PRINT "SAVE A BUCK FOR CAB FARE, SUCKER!":STOP

820 PRINT "$";D;" LEFT"

830 GOTO 300

840 PRINT TAB(19);"!";S$(R(1,A));S$(R(2,B));S$(R(3,C));
    "!";HEX(0D)

850 PRINT HEX(0A);TAB(19);"==========================";
    HEX(0D0C):RETURN

860 END
```

Combination	Reel 1	Reel 2	Reel 3	Total	Payoff	Total Paid
BarBarBar	1	3	1	3	85	255
BellBellBell	1	3	3	9	18	162
BellBellBar	1	3	1	3	18	54
PlumPlumPlum	5	1	5	25	14	350
PlumPlumBar	5	1	1	5	14	70
OrangeOrangeOrange	3	6	7	126	10	1260
OrangeOrangeBar	3	6	1	18	10	180
CherryCherryLemon	7	7	4	196	5	980
CherryCherryBell	7	7	3	147	5	735
CherryCherryAny	7	7	13	637	3	1029
Total amount paid in 8,000 tries						5,957
House odds 2043/8000 = 25.5%						

Table 1. Payoff combinations in 8,000 tries.

payoffs, giving the house an edge of more than 25%. And that doesn't take into account the fact that nearly all of the payoff money is fed right back into the machine.

Program Features

The program simulates the operation of a slot machine and keeps a running total of funds remaining. On the Wang 2200, it takes about 3.2K words of memory. Hex codes are used on the Wang for cursor control. HEX(03) clears the screen and homes the cursor (top left). HEX(0D) returns the cursor to the left end of the current line. HEX(0C) moves the cursor up one line. HEX(0A) moves it down one line. ■

Ham Help

May I take advantage of this column to put out a CQ for any YL pen pals (age 21-22)? I'd like to correspond with, and possibly meet, any YLs having an interest in ham radio. I am presently in the merchant navy working as an electronics officer on the large supertankers "drifting" between Europe and the Gulf states. As of yet, I haven't been allowed to work /MM but would very much like to do so, if it became possible. I'd also like to hear from any PET users in the USA, especially any with Morse/RTTY encoder/decoder software.

All replies will be answered.

Nigel R. Huntley G4CDU
212 St. Stephens Road
Saltash
Cornwall PL12 4NL
England

I would like to invite all hams employed by Hewlett-Packard to join with us at the Eastern Regional Repair Center (ERRC) and Sales Office, Paramus NJ, in the formation of an *active* H-P Amateur Radio Club. We are just getting started and are open to new members and new ideas. We have in mind nets, field days, and fun, as well as getting to know others in the worldwide H-P organization. Anyone interested in signing up and/or starting their own chapter should contact me at the ERRC.

Geoffrey K. Doll WB2KJF
H-P ERRC
Paramus NJ 07652

I desperately need any circuit diagrams, ideas, or technical suggestions for the construction of any audio oscillator, signal generator, or similar gadget that could transmit over short distances (300-400 feet) and be received at, or through, a mobile tape player. The gadget should be similar to a "wireless microphone," but for tape players. Basic modulation, such as a tone beep, would be more than enough.

Dennis P. Sladen VE3DPS
17 Glenshephard Dr.
Scarborough
Ontario M1K 4N2
Canada

I'm having problems hooking up my Tempo 2020 without causing TVI in my townhouse. The closely-run townhouse complex will not allow outside antennas, so I am relegated to a dipole, or something, in the attic. Also, I'm a Technician and desperately need someone to help me get in gear with my code, so I can upgrade. Can someone help this fledgling amateur?

Nolan E. Kienitz WB5WAX
497 Madison Drive
East Windsor NJ 08520
(609)-443-3433

Does anyone have any info on a surplus Navy TCS transmitter? I have one, and want to convert it to use on CW, as it does cover three of the ham bands. It uses two 1625s in the final, two 1625s as modulators, and three 12A6s, too. If you have anything on this transmitter and will mail it to me, I will purchase it from you by return mail. Anything helpful would be appreciated.

Olen Craig W6DIG
2248 Gale Ave.
Long Beach CA 90810

I am in need of a schematic and manual for a Knight Model T-175 6/10 meter linear amplifier. I have tried every place I can think of. This column is my last hope!

Charles Weatherbee WD4CGX
6220 E. 4th Ave.
Hialeah FL 33013

I would like to get in touch with licensed amateurs in the USA who are railwaymen like myself.

Martin Michaelis DK1MM
Waldvereinsweg 5a
D 8400 Regensburg
West Germany

I am looking for a schematic for a crystal receiver for the AM broadcast band—the simpler, the better.

Hersh Goldberg VE3JBU
PO Box 913 Sta. B
Ottawa
Ontario K1P 5P9
Canada

I need any information available (schematic, manual, etc.) on the ARC-33/RT-173 surplus transceiver. I'm particularly interested in modification for use on 220 MHz.

Tom Workman K6TW
8656 W. 66th Place
Arvada CO 80004

I'm looking for someone who can repair an old McElroy (standard model Mac key) bug.

Tom Schlechte
1021 Hunt Ave.
Lakeland FL 33803

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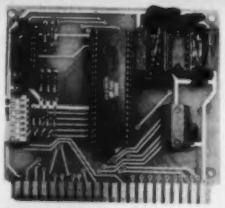

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RS-232/TTL INTERFACE*

Part no. 232

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- Requires -12 and +12 volts
- All connections go to a 10 pin gold plated edge connector
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- Converts a low cost tape recorder to a digital recorder
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- Digital in and out are TTL-serial
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- No coils

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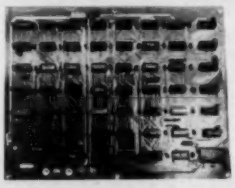

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22 pin	.90	.85	.80	.70	.61	.57
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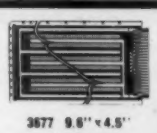

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PART NO.	SIZE	PRICE 1 - 9	10 - 19
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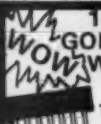

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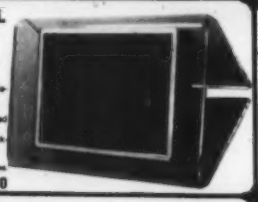

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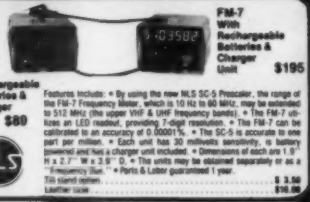

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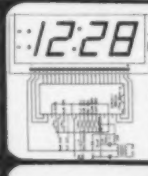

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VHF Notch Filter

—rejection can be beautiful

Having been reintroduced to VHF by modifying an old FM receiver to cover the weather satellite frequencies, I eagerly awaited crystals for a two meter FM rig that I had recently purchased at a hamfest. After plugging the crystals in and erecting a quarter-wave whip in my operating room, I was encouraged to hear the local 19-79 repeater come booming in. Waiting for a pause, I pressed the mike switch to call Norman WB4LJM for an air check. However, the immediate response was noise from the other side of the room.

The weather satellite receiver squelch was being keyed by overload from the two meter rig. It did not take long to determine that the two meter signal was entering the weather satellite receiver through its antenna, all other leads being shielded and filtered. Separating the satellite receiver antenna further from the two meter antenna to reduce coupling is nearly impossible, so I called Norman on the land line to see if we could cook up a filter for the weather satellite receiver. Our first thoughts were for a narrow bandpass cavity, but that idea was rejected for several reasons. First, I am basically lazy and could envision that as a several week project. Second, my operating room, the bedroom, has very limited space and my wife does not think that a copper pipe is as beautiful as I do. Third and finally, the high Q of such a filter would prevent using the weather satellite receiver to monitor police and other services without a coax switch. What was needed was a rejection filter tuned to 146.19 MHz.

A very effective rejection or notch filter can be formed from a wavemeter, i.e., a tuned circuit coupled to the transmission line to couple power out of the line at only one frequency. It was decided that high enough Q could be obtained by using coaxial lines for the resonators. A simple circuit was wired together in a minibox with BNC input and output connectors. Then Norman made a swept frequency response curve. The tap position was changed, and a new curve was measured. The fancy name for this cut-and-try development method is "an empirical investigation."

The actual circuit consists of a shorted one-eighth wave coaxial line that is capacitively tuned to resonance with a small trimmer. The input and output taps are made by cutting the cable and splicing it back together, as shown in Fig. 1. Fig. 2 is the response curve of the filter for various tap positions. The rejection bandwidth, or Q, becomes sharper as the tap is moved towards the shorted end of the coax. The final filter has an insertion loss of about 1.6 dB at 137.5 MHz and a rejection of almost 23 dB at 146.19 MHz. The insertion loss might be reduced if rigid coax having a solid outer conductor is used. The rejection frequency is tunable from 127 MHz to 163 MHz. This filter is easily constructed and will probably find more applications as more systems are added to my station. ■

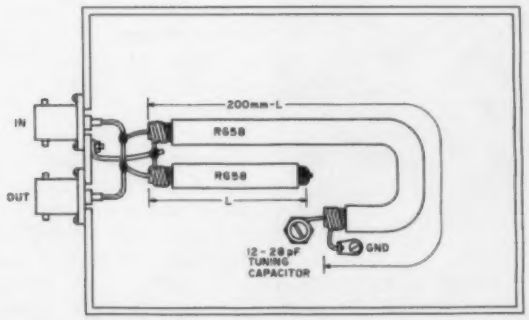

Fig. 1. Construction of the rejection filter.

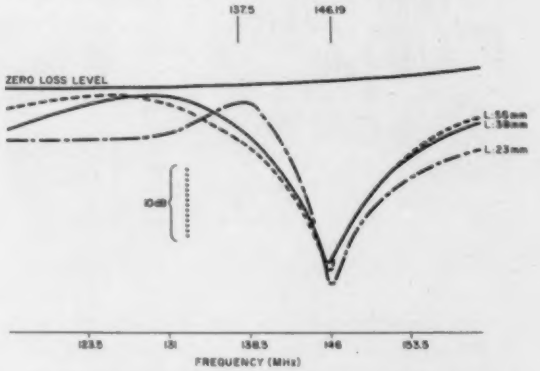

Fig. 2. Response of the filter for various tap positions.

Raymond Seiz K2DVQ
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Yes, You Can Build A Synthesizer!

—220 MHz synthesizer for under $50

A host of articles published in the past years have stated, "Use it or lose it." They are referring to the 220-225 MHz amateur band.

The 550 Amateur Radio Club of Oakland, New Jersey, put a repeater on 223.34 MHz (in) and 224.94 MHz (out). I heard WR2AHD, and my interest in the 220-225 MHz band began. I found the choice of 220-225 MHz rigs limited. Using parts from my junk box and a few added dual-gate MOSFETs, I built a receiver with a first i-f of 10.7 MHz and the second i-f of 455 kHz. The transmitter consists of a modified VHF Engineering TX220B and PA220/15 power amplifier.

I did not want to limit my scope of operation to one or two frequencies. I researched the available synthesizer kit manufacturers in search of a 220-225 MHz synthesizer. As a result of the search, I decided to build my own.

The criteria of design were:

1. Cost — design goal less than $50;
2. Construction — T^2L — PC board;
3. Control switches must indicate frequency of operation in the 220-225 MHz band with 10 kHz steps;
4. Frequency synthesizer must operate in the car, i.e., +12 to 15 V dc;
5. Output frequency must be limited so that out-of-band signals cannot be programmed;
6. Receiver local oscillator injection is on the low side (high-side injection modification as per Figs. 14, 15, and 16).

The synthesizer output frequency was selected to drive the VHF Engineering TX220B transmitter kit. This kit requires 18 MHz crystals (18.333 to 18.750 MHz). The synthesizer output frequency is one-twelfth of the 220-225 MHz band. When used in the receive mode, the synthesizer output frequency is one-twelfth of the 220-225 MHz band minus 10.7 MHz. Receive range is 17.441666 to 17.858333 MHz. The format I decided upon is a heterodyne digital mixer with receiver digital offset.

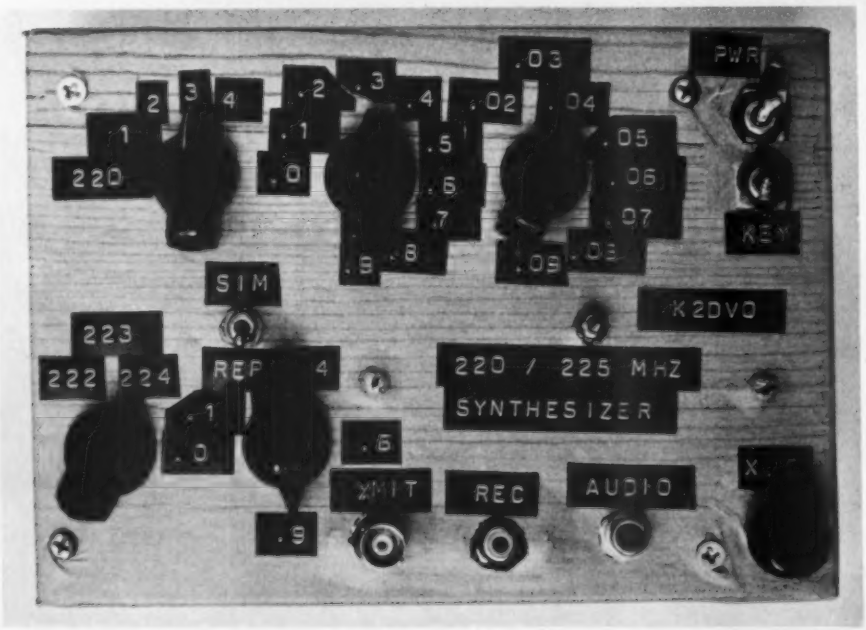
Theory of Operation

This frequency synthesizer generates frequencies from 17.441666 MHz to 18.750 MHz in 833.3333 Hz steps, selectable via the frequency select switches and the transmit/receive mode select signal. The output signal has the ability to be frequency modulated.

This synthesizer is a heterodyne mode phase locked system. (See Fig. 1.) Frequency stability is generated at the crystal reference oscillator. The frequency of the crystal oscillator is 19.083333 MHz. The output of the crystal oscillator is fed to the input of the ÷11,450 counter and to the digital mixer.

The ÷11,450 counter is programmed to count 11,450 pulses at its input and generate a pulse at its output. The counter resets itself after generating an output pulse and counts another 11,450 pulses. This cycle repeats. Each second, 19,083,333 pulses appear at the input and

Photos by John Maio WB2ARS and Matt Maio WB2LHG



This photo shows the controls and input/output ports. The upper switches are set at 223.34 MHz, the transmitter setting. The synthesizer mode switch is in the repeat mode. The lower switches are set at 224.94 MHz, the receiver frequency. The upper .04 setting is common to both sets of switches. (Refer to Fig. 10.)

19,083,333 ÷ 11,450, or 1666.6666, pulses appear at the counter's output terminal. The ÷11,450 counter output is fed to a single-shot chip where the pulse is conditioned and passed to one input of the phase comparator. This constant 1666.6666 Hz signal is the comparator reference signal. The output of the phase comparator is a dc signal which varies the frequency of the voltage controlled oscillator (vco). The output of the phase comparator will continue to change until the frequency and phase of the second input to the phase comparator are equal to the reference input. When and only when both inputs of the phase comparator are equal in phase and frequency, the output signal of the phase comparator will come to rest at some voltage and hold the output frequency of the vco constant. The phase locked mode now exists.

Transmit Mode

Frequency select switches are set to 224.00 MHz. When a ground is applied at the transmit/receive input jack, the synthesizer is in the transmit mode. The output of gate #3 is high (2.4 to 5.4 V dc), driving the control input of gate #1 high. With the frequency select switches set at 224.00 MHz, the 400-to-900 variable counter is programmed to count 500 pulses.

In the phase locked mode, the frequency present at the output of the programmable 400-to-900 counter must be 1666.6666 Hz. The input frequency at the 400-to-900 counter must be 500 times 1666.6666 Hz, or 833.333 kHz. The digital mixer output frequency must be ½ times 833.333 kHz, or 416.666 kHz.

At the output of the digital mixer is a low-pass filter which only passes the difference frequency between its two input signals. One input signal to the digital mixer is the crystal oscillator, 19.083333 MHz. The second input signal to the digital mixer is the vco frequency, 17.4 to 18.75 MHz.

The digital mixer output frequency equals 19.083333 MHz minus the vco frequency. Therefore, the vco frequency equals 19.083333 MHz minus the digital mixer output frequency. With the digital mixer output frequency of 416.666 kHz, the vco frequency must be 19.083333 MHz minus 416.666 kHz, or 18.666666 MHz.

The vco 18.666666 MHz signal is passed through a low-pass filter to the transmit output jack. This 18.666666 MHz signal is multiplied times twelve in the transmitter to obtain the final frequency of 224.00 MHz.

Receive Mode

Frequency select switches are set to 224.00 MHz. When the transmit/receive input jack is left open circuit, or a voltage up to +15 V dc is applied, the synthesizer is in the receive mode.

The reset state sets the output of the JK flip-flop to be high, +2.4 to +5.4 V dc. The output of gate #3 is driven low, 0 to 0.4 V dc. The control input at gate #1 is held low. The pulse train present at the signal input of gate #1 is inhibited and does not pass to the 400-to-900 counter until the control input of gate #1 is high. The pulse train present at the output of the x2 multiplier is fed to the signal input of gate #2. The pulse train is fed to the 1070 counter. When 1070 pulses are counted, the 1070 counter generates an output pulse which sets the JK flip-flop output low, driving the output of gate #3 high, and gate #1 is enabled. The pulse train at gate #1 will now pass to the 400-to-900 counter. After 500 pulses are counted, a reset pulse will reset both the 1070 and 400-to-900 counters. This cycle repeats again and again.

The frequency present at the output of the 400-to-900 counter must be 1666.6666 Hz. The frequency at the output of the times 2 multiplier is the sum of the two counters times 1666.6666 Hz, or 1666.6666 Hz (1070 + 500). 1666.6666 Hz x 1570 = 2.616666 MHz. The frequency at the output of the digital mixer is 2.616666 MHz divided by 2, or 1.308333 MHz. The vco frequency is 19.083333 MHz minus 1.308333 MHz, or 17.775 MHz. When this 17.775 MHz signal is multiplied times 12 in the receiver local oscillator/multiplier chain, it will produce a 213.3 MHz signal to the receiver's first mixer stage. 213.3 MHz is 10.7 MHz less than 224.00 MHz.

Therefore, using a receiver with a 10.7 MHz first i-f, having oscillator injection to the first mixer on the low side (i.e., injection frequency is below the frequency to be received), the receiver will be set to receive 224.00 MHz. The vco frequency is amplified and fed through the filter to the receive output jack. The signal does not pass to the transmit output jack in the receive mode.

Note: If an i-f frequency other than 10.7 MHz is desired, the 1070 counter can be reprogrammed to generate the offset. To compute the number of pulses to be counted, divide the i-f frequency by 10 kHz, i.e., 12 MHz ÷ 10 kHz = 1200. For a first i-f of 12 MHz, the counter is to be programmed to count 1200 pulses. The vco may be modulated to produce a true frequency modulated signal. Power required is 12 to 15 V dc, 400 mA.

Reference Oscillator

The reference oscillator is a single-stage (Q1) crystal oscillator. (See Fig. 2.) The crystal is parallel resonant

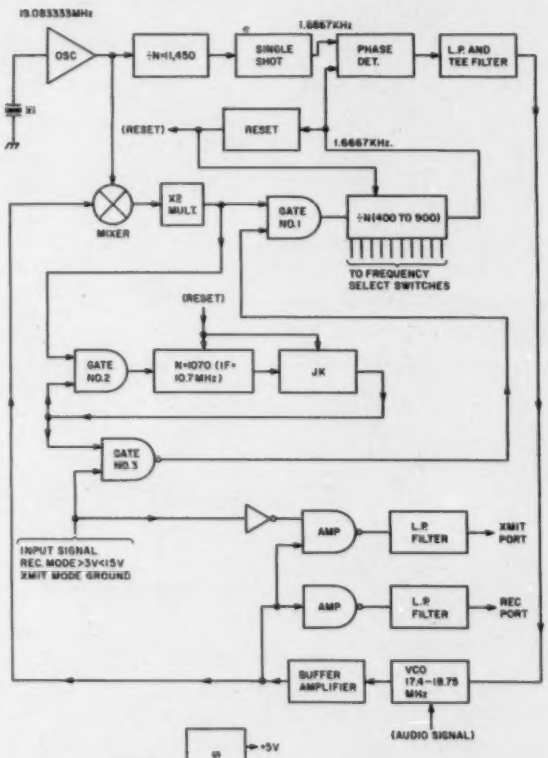
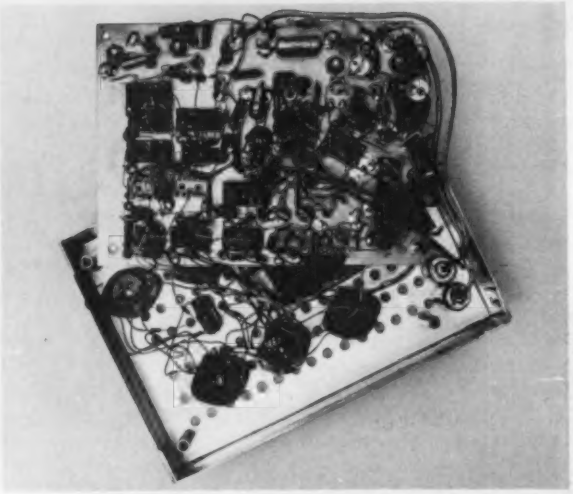


Fig. 1. Block diagram of 220-225 MHz frequency synthesizer.



This photo shows the switches and part of the vco board which are below the main board. Some of the wires from the switches to the main board were cut in order to take this view. The holes shown in the bottom view of the top cover should not be there. This box was retrieved from my junk box and used to contain the synthesizer.

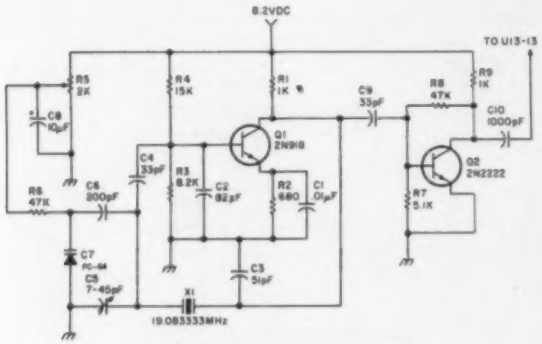


Fig. 2. Reference oscillator.

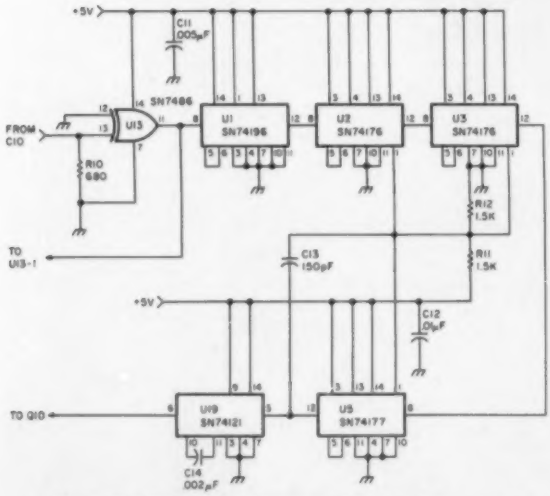


Fig. 3. Divide-by-11,450 presettable decade counter.

"AT" cut for the fundamental mode at 19.083333 MHz (19083.333 kHz). Cp = 32 pF.

The oscillator frequency is pulled or adjusted via the VVC diode C7. A 500 Hz change in oscillator frequency will change the frequency of operation (220 to 225 MHz) by ≈ 6 kHz. R5 controls the bias applied to C7. This adjustment is used to compensate for temperature changes as well as allow for split (5 kHz) channel operation.

Capacitors used were silver mica; C5 is a ceramic trimmer. Capacitor voltage ratings are not critical — any value greater than 25 V may be used.

Q2 is a buffer amplifier. Frequency at C10 is 19.083333 MHz ± Δf of 500 Hz.

Note: The value of R5 is not critical. Its range is 2k to 50k. C5 is adjusted with R5 near center range for 19.083333 MHz at C10. Unless otherwise specified, all resistors are ±5%, ¼ Watt.

The part (or equivalent) used from my junk box: C7 — FC-54 or 1N5144 or MV1404 or MV109 (same as C45).

÷11,450 Presettable Decade Counter

Refer to Fig. 3. The 19.083333 MHz signal is fed to U13-13, shaped, and fed to U1-8. U1 through U5 form a ÷N counter. U1 is operated as a straight ÷10. Due to the high input frequency, 19 MHz, any reset function at U1 would introduce counting error.

The frequency present at U2-8 is 19.083333 MHz ÷ 10, or 1.9083333 MHz. U2 through U5 form a ÷N of 1145. For every 1145 pulses present at U2-8, one pulse appears at U5-12. C13 couples the edge of each pulse at U5-12 to the reset gates of U2, 3, 4, and 5, pin 1.

The frequency present at U5-12 is the frequency at U2-8 ÷ 1145, or 1.9083333 MHz ÷ 1145 = 1666.6666 Hz. U19 is a single-shot used to condition the narrow pulse at U5-12. The signal at U19-6 is a pulse train; frequency is 1.666666 kHz.

Digital Mixer, Low-Pass Filter, x2 Multiplier

Refer to Fig. 4. The reference oscillator signal, 19.083333 MHz, is fed to U13-1. The vco signal, 17.441666 MHz to 18.750 MHz, is fed to U13-2. U13 is an SN7486 2-input exclusive OR gate. The output signal at U13-3 includes the difference frequency between the two inputs at pins 1 and 2. ($f_{pin\ 1}$ - $f_{pin\ 2}$ = signal at pin 3.) To eliminate or reduce $f_{pin\ 1}$, $f_{pin\ 2}$, and $f_{pin\ 1}$ + $f_{pin\ 2}$ present at pin 3, the output signal is passed through a low-pass filter consisting of R13, 14, and C15, 16, and 17. The 0.333333 MHz to 1.641667 MHz pulse train is amplified by Q6 and U13, pin 9 in, pin 8 out. The signal at U13-8 is fed to U11-11 and, via C20, to U12-12. The signal at U13-8 is inverted at U11-10 and fed via C19 to U12-13. The pulse train present at U12-11 is twice the frequency present at U13-8.

U12 inputs pins 12 and 13 are biased high (≈ 3 V), and U12, pin 11 is held high. When U13-8 goes low (changes state), the high-to-low transition is coupled to U12-12, and U12-11 will go low for ≈ 50 nanoseconds and return high. When U13-8 changes state from a low state to the high state, U11-10 will change from a high to a low state. This transition is coupled to U12-13, and U12-11 will go low for ≈ 50 nanoseconds. The signal at U12-11 is a pulse train consisting of 50 nanosecond pulses at a repetition frequency twice that present at U13-8. Frequency range at U12-11 is 0.666666 MHz to 3.283334 MHz.

Controllable Presettable Decade Counter

Refer to Fig. 5. U8, U9, and U10 are presettable decade counter chips. The data input pins, 3, 4, 10, and 11,

are wired to the frequency select switches. These counters are so wired that when the frequency select switches are set to 220.00 MHz, U10, U9, and U8 will count 900 pulses, generate a pulse at U8-12, reset the data inputs, and then count to 900 again. With the frequency select switches set to 224.00 MHz, the counters are programmed to count 500 pulses and generate a pulse at U8-12.

N = number of pulses to be counted. The vco frequency = 19.083333 MHz - (1666.666 Hz x N)/2.

When N = 900, vco = 18.333334 MHz. 18.333334 MHz x 12 = 220.00 MHz.

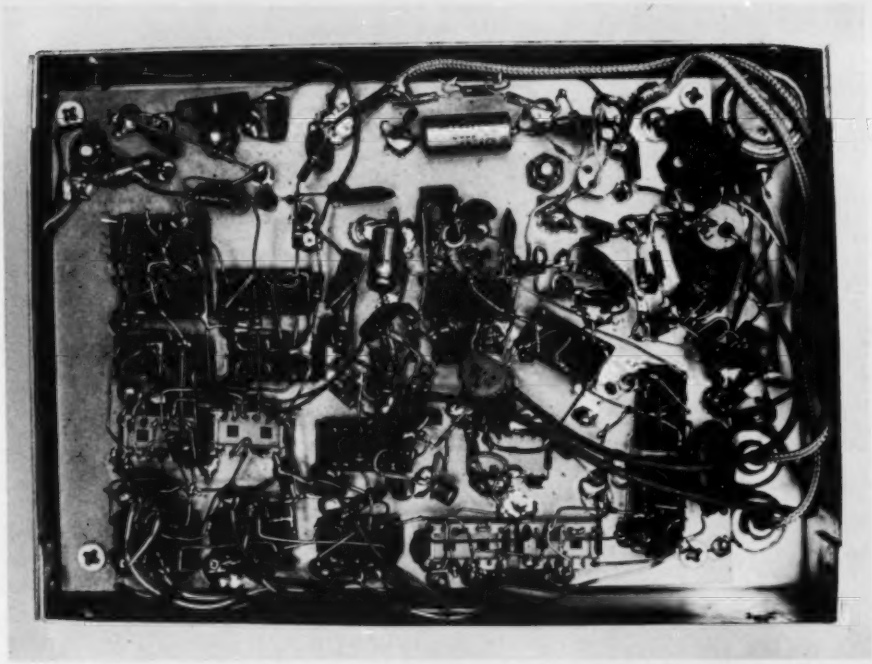
When N = 500, vco = 18.666667 MHz. 18.666667 MHz x 12 = 224.00 MHz.

The signal at U12-1 is a pulse train within the frequency range of 0.666666 MHz to 3.283334 MHz. The signal at U12-2 is held high, 2.4 to 5.25 volts, in the transmit mode. In the receive mode, U12-2 is held in the low state, less than 0.4 volts, until the receiver offset counter of Fig. 9 sets U18-2 to the high state, which drives U12-2 high. The pulse train at U12-1 cannot pass to U12-3 with U12-2 held low. When U12-2 is at a high state, the pulse train will pass to U10-8 and be counted in U8, U9, and U10. When the counters count the number of pulses programmed via the frequency select switches, U8-12 will change state from a high of 2.4 to 5.25 volts to a low of less than 0.4 volts. This high-to-low transition is coupled to U11-1 via C32. A pulse of approximately 50 nanoseconds is generated at U11-2 and U11-4. This pulse is used to reset counters U8, U9, U10, U14, U15, U16, U17, and U18. There is more than ample time for the counters to be reset to their data inputs before the next pulse is present at U12-1. The maximum frequency at U12-1 is 3.283334 MHz, with a period of 304 nanoseconds.

Note: If cost is not a factor, use SN74LS196 chips in place of SN74176 chips at U8, U9, and U10. If you wish to save a few dollars, use selected SN74176 chips at U8, U9, and U10.

To select the ICs with low input current at the data inputs, build a test fixture consisting of a 14-pin IC socket and four 1k Ohm ±5% ¼-Watt resistors. Connect +5 volts to pins 1, 13, and 14. Connect ground to pin 7. Connect a 1k Ohm resistor to pin 3, pin 4, pin 10, and pin 11. The other end of each resistor connects to ground.

Install the SN74176 chip to be tested into the test fixture. Apply +5 volts. Using a high impedance voltmeter, measure the voltage drop across each 1k Ohm resistor. Any SN74176 with all four voltage readings below 0.6 volts is okay to use at U8, U9, and U10. Since you have taken the time to make the test fixture, record readings on all the SN74176 ICs, and use the three with the lowest readings at U8, U9, and U10. The remaining SN74176s can be used as required at U2, U3, U4, U5, U14, U15, U16, and U17. In these positions, the data inputs are hard wired to +5 volts or ground. The input current can be larger and not influence operation.



This photo is a close-up of the main board. You are looking down at the IC socket pins. See Fig. 12 for IC locations. This board is held above the frequency select switches on four standoffs.

Phase Comparator, Low-Pass Filter, Twin-Tee Filter

Refer to Fig. 6. The signal

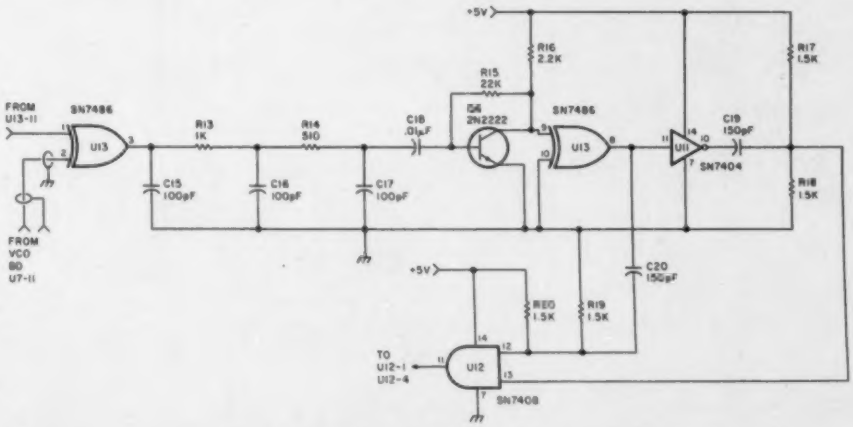


Fig. 4. Digital mixer, low-pass filter, x 2 multiplier.

at R34 consists of a pulse train at a 1666.666 Hz rate. This 1666.666 Hz signal is the phase comparator's reference signal. The signal at R36, when the system is in the locked condition, shall be equal in frequency and in phase to the reference signal at R34. Q10 and Q11 are level shifters. The output levels at U19-6 and U8-12 are TTL; each pulse changes from a low state of less than 0.4 volts to a high state of 2.4 to 5.25 volts. The input levels required at U6-3 and U6-14 are a low state of less than 2 volts and a high state of 8 to 11 volts. Q10 and Q11 switch levels between 0.2 volts and approximately 11 volts.

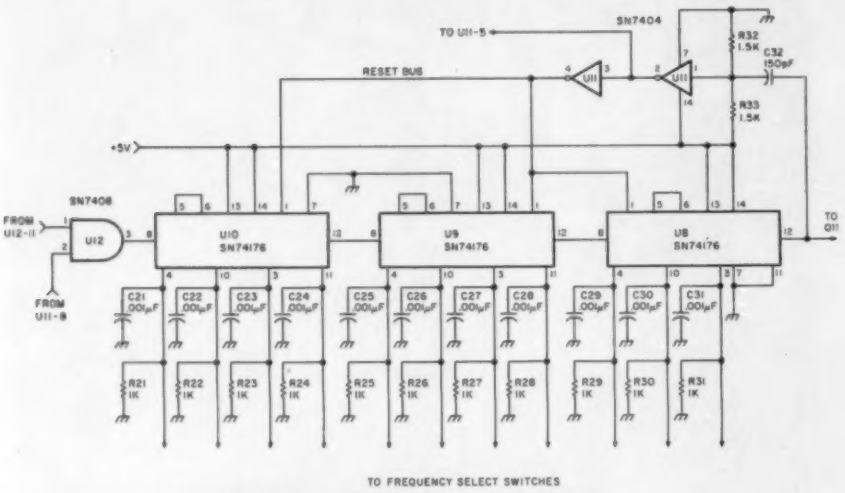


Fig. 5. Controllable presettable decade counter.

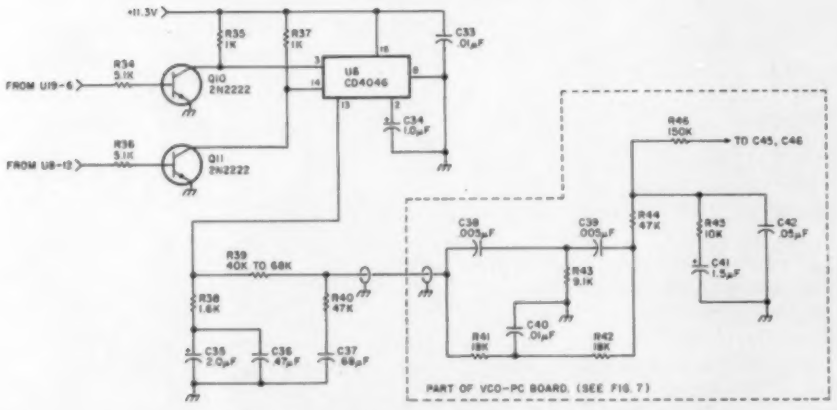


Fig. 6. Phase comparator, low-pass filter, twin-tee filter.

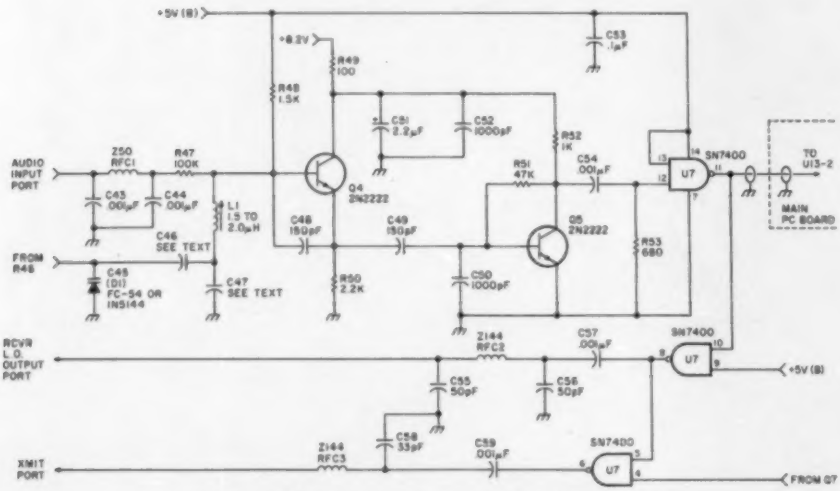


Fig. 7. Vco and output circuits (vco PC board).

U6 is a COS/MOS-type IC phase comparator. This chip compares the frequency and phase of the pulse trains present at its inputs, U6-3 and U6-14. If the input signals are not equal in frequency and in phase, the phase comparator output U6-13 is driven more positive or less positive. The phase comparator output is a dc bias voltage which is fed to C45, the vco VVC diode. As the voltage level at U6-13 changes, the bias on C45 changes, and the frequency of the vco changes. When the inputs at U6-3 and U6-14 are of equal frequency and they are phase locked, the output level at U6-13 will remain constant, holding the vco frequency constant until the operator changes the frequency select switches.

The output of U6-13 passes through a low-pass filter – R38, R39, R40, C35, C36, and C37. The signal then passes through a twin-tee filter to remove any 1666.666 Hz ripple present. The twin-tee filter consists of R41, R42, R43, C38, C39, and C40. R45, C41, and C42 comprise a charge storage network to hold the dc voltage constant until the next information update. R46 passes the dc level to the VVC diode, C45, while it isolates the capacity of C42.

Note: The value of R39 is 68,000 Ohms. If a value near 40,000 Ohms is used, response time is decreased with a trade-off in greater ripple present at C45. C34 was added to eliminate cross-talk present in the CD4046 chip.

Voltage Controlled Oscillator and Output Circuits

Refer to Fig. 7. Q4 is the voltage controlled oscillator (vco). This is a modified Clapp oscillator. The frequency determining components are L1, C45, C46, and C47. I selected a ¼-inch slug coil form and wound it for approximately 1.75 uH with the slug at its midrange. I used a known ±10% capacitor across the coil L1 and a grid-dip meter to indicate frequency of resonance. With L1 = 1.75 uH, at 18.75 MHz, C total = approximately 41 pF. At 17.44 MHz, C total = approximately 47.5 pF. The operational range of the bias applied to C45 is between 2 volts and 6 volts. The change in capacity of C45 is from approximately 15 pF at 2 volts to approximately 5 pF at 6 volts. Since only a 6.5 pF change in capacity is required to change the frequency of operation from 17.44 MHz to 18.75 MHz, the values of C46 and C47 were chosen with the total capacity across C47 in the range of 41 to 47.5 pF. Actual calculation required that C46 be 39 pF and C47 be 36 pF. I used two 18 pF capacitors in parallel for C47. L1 can be adjusted to bring the oscillator into range. If other VVCs are used for C45, use their curves of capacity vs. voltage to compute the capacity ratio of C46 and C47. A method of adjusting or testing the vco prior to closing the loop is to disconnect R46 at C45, connect a 50k Ohm pot to +8.2 volts and ground, connect a 100,000-Ohm resistor to the arm of the pot, and connect the other end of the 100,000-Ohm resistor to C45. Use a voltmeter to monitor the voltage at the arm of the pot. Adjust it for approximately 2 volts, and adjust L1 for approximately 17.4 MHz. The frequency measurement source may be a counter, an allband receiver, or a grid-dip meter. Adjust the pot for approximately 6 volts. Frequency of the vco should be greater than 18.75 MHz, but less than 19.0 MHz. Balance L1, C46, and C47 as required. Remove the pot and the 100,000-Ohm resistor. Connect C45 to R46.

The vco can be frequency modulated by applying approximately 0.5 volts of audio at the audio input port. The audio source must be capacitive coupled, or you must add a .1 uF capacitor in series with RFC1. Q5 is a buffer amplifier. The signal at U7-11 is fed to the main board at U13-2, which is ½ of the mixer input. (See Fig. 4.) The output at U7-8 is fed through a low-pass filter to the receiver output port. The control signal at U7-4 is high, 2.4 to 5.25 volts, only when a

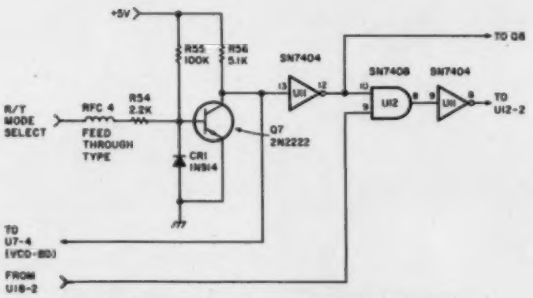


Fig. 8. Transmit/receive mode control circuits.

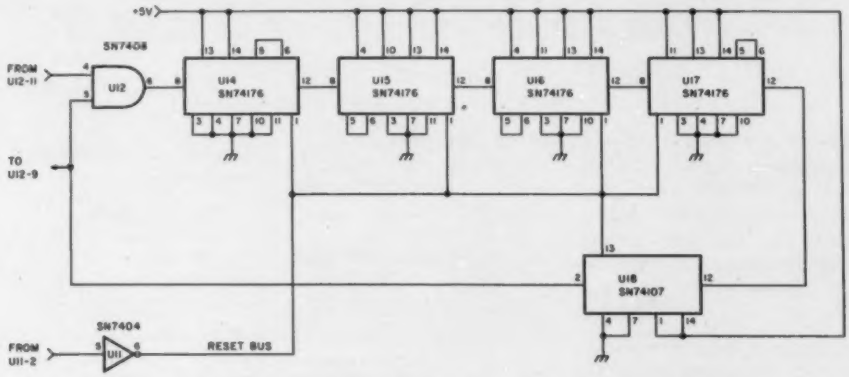


Fig. 9. Receiver offset presettable decade counter (i-f of 10.7 MHz).

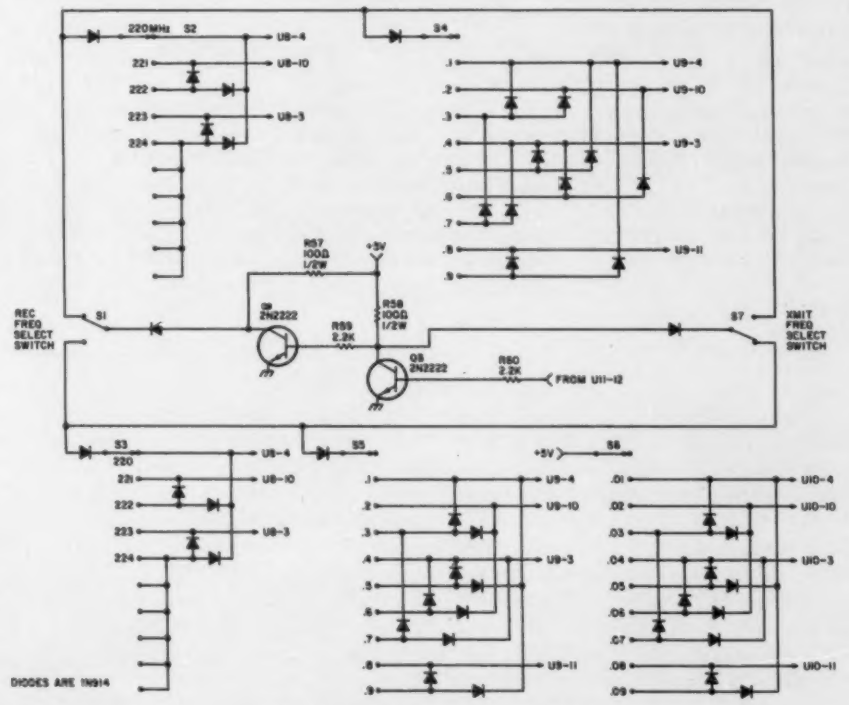


Fig. 10. Frequency select switching.

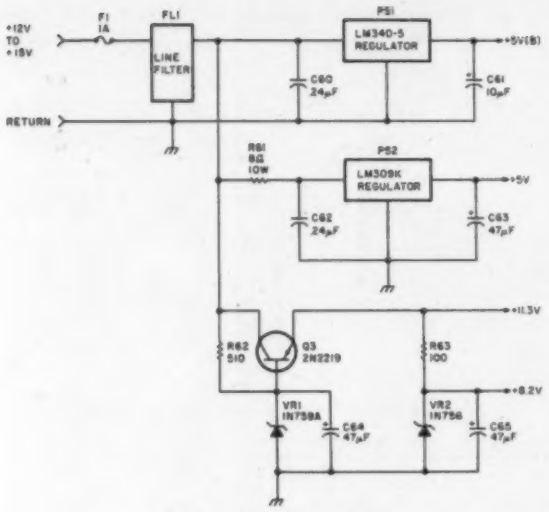


Fig. 11. Voltage regulators.

ground is present at the R/T mode port. A ground is present at the R/T mode port only in the transmit mode. (See Fig. 8.) Only in the transmit mode is the vco signal present at U7-6 and at the transmit port.

Note: I used G.E. clear silicone compound to reduce vibration effects. Coat L1 and all components in the area of L1. The parts (or equivalent) I used from my junk box are:

Audio input port – RCA phono jack;
Receiver L.O. output port – BNC chassis mount;
Transmit port – BNC chassis mount;
RFC1 – ohmite Z50;
RFC2, RFC3 – ohmite Z144;
C45 (D1) – FC-54 Fujitsu, Nissho America Corp., 80 Pine Street, New York NY 10005; or 1N5144, MV1404, or MV109.

Transmit/Receive Mode Control Circuits

Refer to Fig. 8. The range of signal levels to be applied at the R/T mode select port is zero or ground to 15 volts or an open circuit. In the receive mode, the R/T mode port should see an open-circuit condition, or you can apply a voltage between 3 and 15 volts. In the receive mode, Q7 is in the on state; Q7's collector is at less than 0.4 volts. U11-12 is at a high state, 2.4 to 5.25 volts. In the transmit mode, a ground is applied at the R/T mode port. Q7 is in the off state, and its collector is at a level between 2.4 and 5.25 volts. U11-12 is low, less than 0.4 volts. In this mode, U12-8 is held low, and U11-8 is at a high state, holding U12-2 high. U12-2 is the count-enable gate to the controllable presettable counter. (See Fig. 5.)

In the receive mode, the level at U12-9 is held high until the receiver offset counter counts 1070 pulses and U18-2 is driven low. U12-8 then goes low and drives U11-8 high, which enables the controllable presettable counter.

The part (or equivalent) used from my junk box is: RFC4 – Erie, part number 1270-009, 1270-024, or 1201 or 1202.

Receiver Offset Presettable Decade Counter

Refer to Fig. 9. The signal at U12-11 is a pulse train. The frequency of the pulse train varies between 666,666 Hz and 3.283334 MHz. This signal is fed to the input gate of U12-4. With U18 in the reset mode, U18-2 is at a high state, and U12-5 is at a high state. The pulse train at U12-4 will pass to U12-6 to be counted by U14, U15, U16, and U17. When U17-12 changes state, U18-2 will go to the low state and remain low until a reset pulse is present at U11-5.

As shown in Fig. 9, U14, U15, U16, and U17 are wired to count 1070 pulses. Each pulse at U12-4 has the effect of a 10 kHz offset at 220-225 MHz. The effect of adding the presettable counter to the controllable counter (see Fig. 5) is to force the vco in the receive mode to change frequency by a fixed amount. The fixed amount of offset is equal to the receiver's first i-f, 10 kHz.

As an example, set the frequency select switches to 224.94 MHz. In the transmit mode, the vco frequency is 224.94 MHz/12, or 18.745 MHz. In the receive mode, the vco must shift to (224.94 MHz - 10.7 MHz)/12, or 17.853333 MHz. For any frequency selected, the -10.7 MHz term is a constant. The vco in the receive mode will be forced to shift lower due to the phase comparator seeking locked condition. The frequency at U6-14 must equal the frequency at U6-3, which is a constant 1666.666 Hz.

As the offset of 1070 pulses is added to the scaled count of U8, U9, and U10, the frequency at U12-11 must increase. The frequency out of the mixer U13-3 can increase only when the frequency difference between U13-1 and U13-2 increases. The signal at U13-1 is a fixed 19.083333 MHz from the crystal oscillator. Therefore, the vco frequency at U13-2 must be driven lower.

If your receiver has a first i-f other than 10.7 MHz, the counters U14, U15, U16, and U17 must be reprogrammed: i-f/10 kHz = number of pulses to be counted.

As an example, if an i-f of 12 MHz is used, 12 MHz/10 kHz = 1200 pulses, and U14, U15, U16, and U17 must be programmed to count 1200 pulses.

This scheme as shown is for low-side injection. Frequency at mixer U13-3 = (1666.666 Hz x N)/2. Frequency of the vco = 19.083333 MHz - frequency at U13-3. N is the total number of pulses that the counters are programmed to count.

Frequency Select Switching

Refer to Fig. 10. The data input code required to pro-

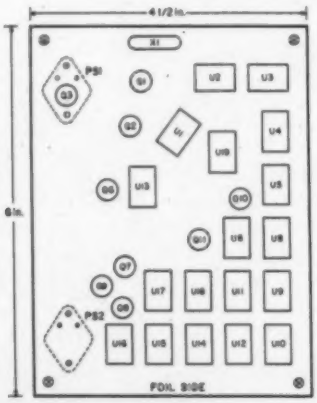


Fig. 12. Main circuit board IC layout.

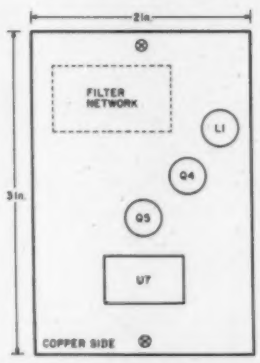


Fig. 13. Vco board parts layout.

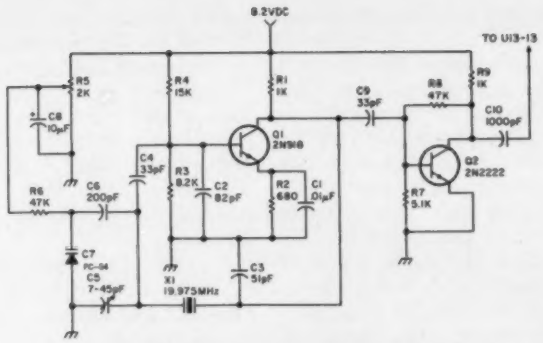


Fig. 14. Reference oscillator (high-side injection).

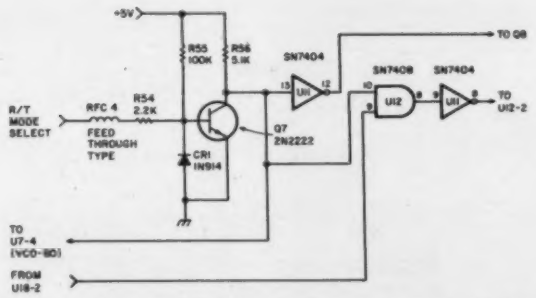


Fig. 15. Transmit/receive mode control circuits (high-side injection).

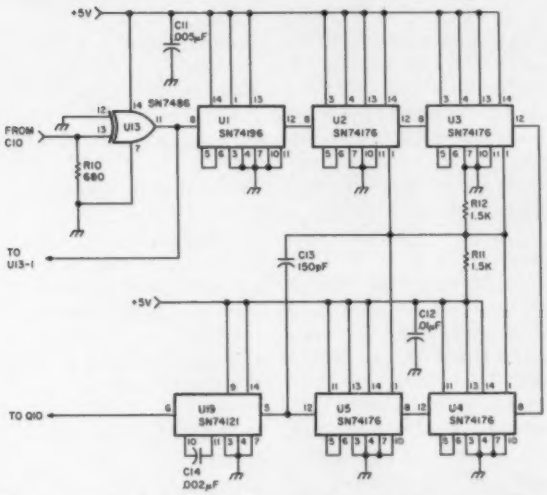


Fig. 16. Divide-by-11,985 presettable decade counter (high-side injection).

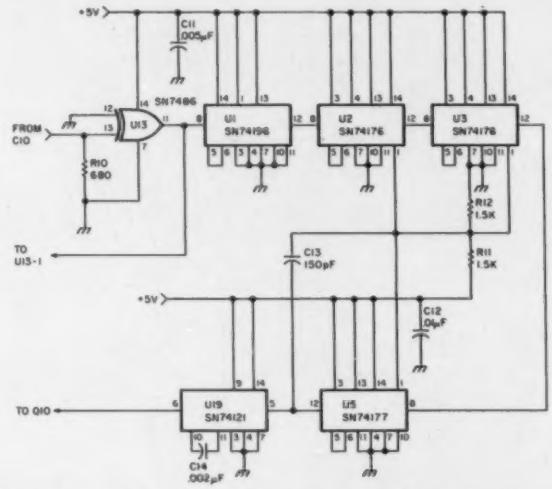


Fig. 17. Divide-by-11,450 presettable decade counter — alternate circuit to replace Fig. 3. This circuit requires one less chip (U4).

gram the presettable decade counters U8, U9, and U10 of Fig. 5 is binary coded decimal (BCD). I did not locate BCD switches for less than $2.00. I purchased five single-pole 10-position switches for $0.99 each from Radio Shack. Using the diode-switch scheme shown in Fig. 10, the switches were converted to BCD. Only five switches were used. The .01 MHz switch, S6, is common to both banks of switches. Another switch can be added to the S2, S4 bank wired as S6 is, with a diode in series with its arm common with the diodes from the arms of S2 and S4. Add a diode in series with the arm of S6, and wire its anode to the anodes of the diodes from the arms of S3 and S5. Now the operator can offset both transmit and receive frequencies in the 0.01 MHz range.

The REC select switch, S1, selects the frequency in the receive mode. The XMIT select switch, S7, selects the frequency in the transmit mode. The operator sets the transmit and receive frequencies as a direct readout of the frequency select switches. With S2 set to 2, S4 set to 3, and S6 set to 5, the frequency of operation is 222.350 MHz. With S3 set to 3, S5 set to 5, and S6 set to 0, the frequency of operation is 223.500 MHz.

In the receive mode, 2.4 to 5.25 volts is applied to R60. Q8 will conduct and Q9 will be off. When Q9 is off, greater than 3 volts is applied at the arm of S1. The data gates of U8 and U9 will then come under control of S2 and 4 or S3 and 5, as controlled by the position of S1. In the transmit mode, Q8 is off and Q9 is on. Between 3 and 5 volts is applied to the arm of S7. The position of S7 will select the frequency code to be sent to U8 and U9. When Q8 is on, Q9 is off, and when Q8 is off, Q9 is on. In the on state, less than 0.4 volts is applied to the diode at its collector, so the switch connected to the on transistor has no effect on the frequency programming.

Power Requirements

See Fig. 11. TTL logic requires 4.75 to 5.25 volts. Two 5-volt regulators were used. One would be ample, but I used a second 5-volt regulator to power the vco output chip. R61 is not required if PS2 is attached to the metal frame, heat sink of the synthesizer. I mounted PS2 to the PC board. R61 will limit the power dissipation of PS2. FL1 is a line input filter. Q3 is an emitter follower used to generate and filter the 11.3-volt source. This synthesizer was designed to operate from a source of 12 to 15 volts.

The part (or equivalent) used from my junk box is: FL1 — Erie, low-pass/high-frequency filter, type 1270-009, 1270-024, or feed-through-type 1201 or 1202, etc.

Construction

Refer to Figs. 12 and 13. The transistors and the integrated circuit chips (IC) are mounted on two copperclad boards. The copper is used as a ground plane. The ICs are

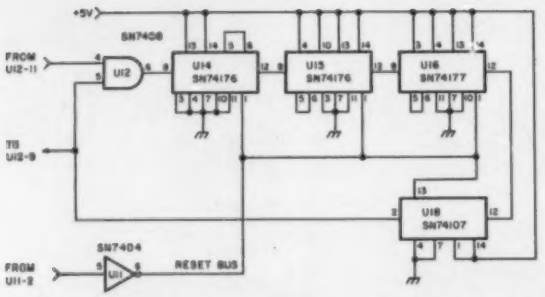


Fig. 18. Receiver offset presettable decade counter (i-f of 10.7 MHz) — alternate circuit to replace Fig. 9. This circuit requires one less chip (U17).

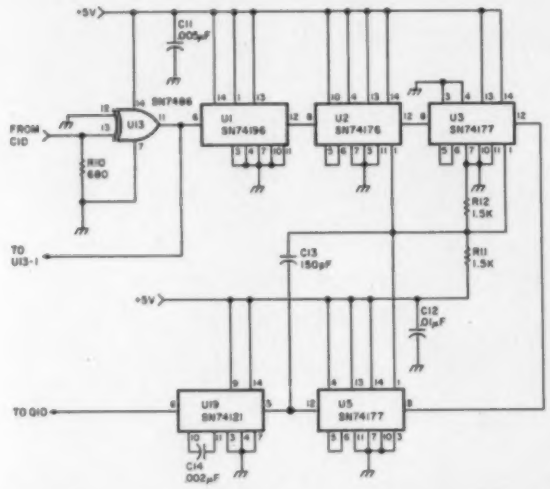


Fig. 19. Divide-by-11,985 presettable decade counter. This circuit is used with high-side injection. It is an alternate circuit to replace Fig. 16. This circuit requires one less chip (U4).

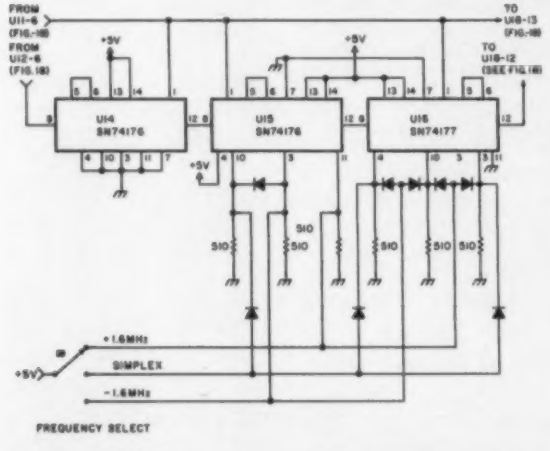


Fig. 20. Alternate circuit to eliminate the second set of frequency select switches. This circuit allows one switch selection of repeater or simplex modes (i-f 10.7 MHz). Note: Diodes are 1N914. Resistors are 510 Ohms, ±5%, ¼ W. Add .001 µF across each 510Ω resistor.

installed in 14 or 16 pin dual in-line sockets, then mounted upside down. The IC top is up against the copper with the socket pins up away from the board. All ground connections are as short as possible from the copper ground plane to the ICs' socket pins. The ground connections hold the ICs to the board. The 5-volt regulators are mounted to the main copperclad board. Due to ground loops, the vco and the output IC (U7) are located on a small separate copperclad board. I suggest that this vco board be mounted in the enclosure to position the coil (L1) form parallel to the Earth's surface when in use. The vco frequency is less susceptible to shock or vibration with the coil windings perpendicular to the direction of induced shock.

The two boards were mounted in a 5" x 7" x 3" aluminum box with a bottom plate. The frequency select switches are accessible at the top. I did not experience the presence of rf feedthrough problems when driving the 15-Watt transmitter.

The enclosure should be rf tight. Use rf feedthrough decoupling for both power and mode select (transmit/receive) inputs.

Note 1 — Crystal Oscillator R5 Adjustment

Crystal oscillator R5 adjustment is made using the receiver audio or discriminator meter as a guide.

Note 2 — Receiver High-Side Injection

If your QTH is in an area where television transmission in the 198 to 204 MHz range presents image problems, you can shift the image frequency above 240 MHz by using high-side local oscillator injection in the receiver. The following changes are required to convert the synthesizer to high-side injection for use with a receiver with a first i-f of 10.7 MHz:

1) Crystal X1 should be 19.975 MHz, parallel mode, 32 pF load capacity, fundamental mode.

2) Program the presettable decade counter to ÷11,985 as follows:

Remove the jumper between U1 pins 5 and 6;
Remove the input at U1-8 and connect it at U1-6;
Remove the connection at U2-3;
Remove the connection at U2-10;
Connect U2-3 to ground;
Connect U2-10 to +5 volts;
Remove the connection at U3-3;
Remove the connection at U3-4;
Connect U3-3 and U3-4 to ground;
Remove the connection at U4-3;
Remove the connection at U4-10;
Remove the connection at U4-11;
Connect U4-3 to +5 volts;
Connect U4-10 to +5 volts;
Connect U4-11 to ground;
Remove the connections at U5 pins 3, 4, 10, and 11;
Connect U5 pins 3, 4, and 10 to +5 volts;
Connect U5-11 to ground;
Remove the connection at U12-10;
Connect U12-10 to U11-13;
Retune vco L1 to cover 18.3 to 19.7 MHz. If required, retune your receiver local oscillator/multiplier chain.

Cost

As of the January, 1978, issue of *73 Magazine*, the cost of all ICs, diodes, transistors, regulators, and VVCs was $25.01.

Options

Figs. 2 through 13 define the basic 220 to 225 MHz frequency synthesizer. The following schematics are options which may be used in place of Figs. 2 through 13, as desired.

1. High-side injection — Replace Fig. 2 with Fig. 14; replace Fig. 3 with Fig. 16; and replace Fig. 8 with Fig. 15.

2. Single-frequency select switching with simplex repeater mode switch (repeater offset — 1.6 MHz) — refer to

Fig. 10. Delete the following parts: S1, S2, S4, Q9, Q8, R57, R58, R59, R60, S7, and the diodes in series with the arms of S3 an; S5. Connect the arm of S3 to +5 volts. Connect the arm of S5 to +5 volts. S3, S5, and S6 are the frequency select switches.

The mode select switch is added as follows: Replace Fig. 9 with Fig. 18. Modify Fig. 18 by adding S8, the diodes, capacitors, and resistor of Fig. 20.

Note that with low-side injection, the frequency select switches set the transmitter frequency in the repeat mode. The receiver frequency will be offset 1.6 MHz.

Note that with high-side injection, the frequency select switches set the receiver frequency in the repeat mode. The transmitter frequency will be offset 1.6 MHz.

3. Parts reduction — The number of ICs can be reduced by two. U4 and U17 can be eliminated. Replace Fig. 3 with Fig. 17. Replace Fig. 9 with Fig. 18. Note that U5 and U16 are changed from SN74176 to SN74177.

If you use high-side injection, replace Fig. 16 with Fig. 19 and replace Fig. 9 with Fig. 18. Note that U3, U5, and U16 are now SN74177.

As you can see, a PC board is not required to make this synthesizer. This scheme can be modified for use on 2 meters or at 440 MHz.

If you have any specific questions related to this 220-225 MHz frequency synthesizer, send me the questions and a stamped self-addressed envelope. ■

References

1. *RCA COS/MOS Integrated Circuits*, SSD-203C, 1975 Data Book Series, pages 227 through 233.
2. "The RCA COS/MOS Phase Locked Loop ...", *COS/MOS Micropower Phase Locked Loop*, pages 471 through 478.
3. *The TTL Data Book*, Texas Instruments, 1973, pages 62, 63, 64, 79, 82, 86, 94, 120, 134, 209, 369, and 451.

Social Events

RAPID CITY SD
JUL 1-2

The annual South Dakota hamfest will be held on July 1 and 2, 1978, at Surbeck Center on the campus of the South Dakota School of Mines and Technology, Rapid City, South Dakota. There will be technical forums, an ARRL forum, a flea market, and industrial tours. The grand prize will be a Kenwood TS-520S; the preregistration prize will be a Kenwood TR-7500. Admission is $4.50 in advance (before June 1) or $5.00 at the door. Plan to include this on a vacation to the Black Hills for the July 4th weekend. We recommend early reservations for accommodations. For more information and/or assistance with reservations, write to Black Hills ARC, Box 1014, Rapid City SD 57709.

BRIDGETON MO
JUL 6-8

The ICHN/MARAC 10th annual convention will be held July 6, 7, and 8 at the Holiday Inn, 4545 N. Lindburg Blvd., Bridgeton MO. This convention will involve amateur radio operators from every part of the United States and several DX stations, all sharing a common interest in county hunting and mobile operation. The election of MARAC officers, meetings, workshops, and some important social activities will highlight this year's convention. Of course, there will be prizes and awards to add spice to the festivities. Those interested in attending this year's convention can send for information from Convention Director Jim Glascock WØFF, 3416 Manhattan Ave., St. Louis MO 63143.

WELLINGTON OH
JUL 8

The NOARSFEST will be held on Saturday, July 8, from 7:00 am to 6:00 pm, at the Lorain County Fairgrounds, Wellington OH. There will be a well-marked, paved flea market area. A DenTron DTR-1 transceiver will be given away as well as 100 other prizes. Tickets are $1.50 before July 1 and $2.00 at the gate. Talk-in on 146.10/70. Mobile check-in for prizes on 146.52. For further info, contact NOARSFEST, PO Box 354, Lorain OH 44052.

CUMMINGTON MA
JUL 8-9

The Northern Berkshire Amateur Radio Club's hamfest will be held on July 8th and 9th at the Cummington Fair Grounds, Cummington, Massachusetts. There will be free overnight camping, technical talks, demonstrations, and dealers. The flea market will cost $1. Admission will be $4 or, with spouse, $6. Advanced tickets are $3 and $5. For information write: Hildy Sheerin WA1ZNE, 89 Greylock Terrace, Pittsfield MA 01201.

CHARLESTON SC
JUL 8-9

The Charlestowne Hamfest will be held July 8-9 at Gaillard Municipal Auditorium, 77 Calhoun Street, beginning on Saturday, July 8, at 8:00 am. Events include FCC exams on Saturday at 8:00 am, planned ladies' activities, and a Social Room Saturday at 7:30 pm. Admission charge is $3.00. Tables are available for $3.00. Free refreshments. Talk-in on 34/94. For further information, write to PO Box 4555, Charleston SC 29405.

INT'L PEACE GARDENS MANITOBA
JUL 8-9

The 15th annual International Hamfest at the Canadian Pavilion in the International Peace Gardens will be held on Saturday and Sunday, July 8-9, beginning at 2:00 pm. Transmitter hunts, contests, door prizes, and lots of other social activities. Admission is $5.00 for hams, $2.00 for non-hams, and children are free. Plenty of camping facilities. Talk-in on 34/94, 3990, and 3778 kHz. For further info, contact Lynn A. Nelson WAØWB6, 1301 2nd Ave. W., Devils Lake ND 58301 or Reginald G. Edworthy VE4RW, 449 7th St., Brandon, Man. R7A 3S9.

INDIANAPOLIS IN
JUL 9

The Indianapolis hamfest will be held on Sunday, July 9, 1978. The gates will be open from 6:00 am to 4:30 pm. The place is the Marion County Fairgrounds, S.E. corner, in Indianapolis, Indiana. There will be professional commercial exhibiting, a covered flea market, and an unlimited outside flea market. Overnight camping facilities with hookup are available. For information, write to Indianapolis Hamfest, PO Box 1002, Indianapolis IN 46206.

ESSEX MT
JUL 15-16

The International Glacier-Waterton Hamfest will be held on July 15-16, 1978, in the West Glacier Area, Montana. The location will be at the Three Forks Campground, 10 miles east of Essex MT on U.S. Highway 2. Registration begins at 9:00 am MST.

BOWLING GREEN OH
JUL 16

The Wood County, Ohio, 14th annual Ham-a-Rama will be held on Sunday, July 16, at the fairgrounds in Bowling Green (just off I-75). Gates open at 10:00 am. Admission and parking are free. Tables are available for $3.00 or 8-foot spaces for $2.00 (advance table or space rental to dealers only). Trunk-sale space and food will also be available. There will be a main prize drawing and lots of door prizes. K8TIH talk-in on 146.52 simplex. Tickets are $1.50 in advance, $2.00 at the door. Write to Wood County Amateur Radio Club, c/o Eric Willman, 14118 Bishop Road, Bowling Green, Ohio 43402.

ARLINGTON VA
JUL 22-23

The Amateur Computing 78 microcomputer festival will be held July 22-23 at the Sheraton National Motor Hotel, Columbia Pike and Washington Blvd., Arlington VA. The show will feature commercial exhibits, personal computer displays, seminars, and club activities. Computer hobbyists and the general public are welcome. Registration at the door for two full days is $5.00 (spouse and children of ticket holder admitted free). If not sold out, Saturday night banquet tickets are $14.00 per person if purchased at the show. Admission tickets are $4.00 and the banquet tickets are $12.00 per person, if ordered in advance by mail. Send check payable to AMRAD to PO Box 682, McLean VA 22101.

MARSHALL MO
JUL 23

The Indian Foothills Amateur Radio Club, Inc., will hold its third annual hamfest on July 23, 1978, in an air-conditioned multipurpose building at the Saline County Fairgrounds in Marshall, Missouri. There will be flea markets for the OM and XYL (tables—$2.00 for first table; $1.00 for each additional table). Many prizes are to be awarded and there will be old and new equipment displays. Campgrounds (no connections for utilities) are available. The timetable is 8:00 am—registration; 8:00 am to 10:00 am—breakfast rolls and coffee; 11:30 am—lunch—all you can

Continued on page 144

Beat the Microphone Blahs

—more oomph for FM audio

George K. Fallenbeck K1HQW/4
1008 Pine Lake Drive
Niceville FL 32578

Are you plagued by a microphone which generates insufficient output? Do you have to darn near swallow the thing to obtain decent modulation? Is your FM rig's deviation control wide open, and you're still getting reports of low audio? Read on, for the cure is at hand!

The Heath Micoder has an output of 30 mV, which is supposedly enough to drive the input speech clipper of the HW-2036 into limiting. This would tend to hold the audio level constant over a reasonable range. My HW-2036 was not being driven sufficiently. If I backed off from the mike the least bit, the modulation dropped drastically. The transceiver input seemed sensitive enough, since the touchtone™ level was perfect for the rather finicky local repeater's autopatch with the touchtone level pot in the Micoder set at only 50% of maximum. That left the fancy electret capacitor mike in the Micoder as the culprit. Its output was already boosted by an integral preamp, but it wasn't sufficient. A fair proportion of the HW-2036 owners in the area have the same problem. What quick, dirty fix would boost the gain?

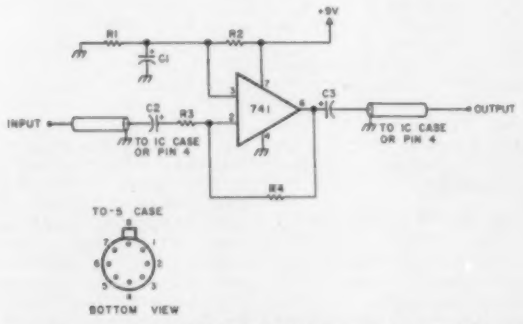


Fig. 1. IC – LM741CH, TO-5 metal case style, available from James Electronics (if different case configuration is used, pinout may be different); C1 – 5 uF or larger tantalum; C2, C3 – .1 uF tantalum; R1, R2 – 4.7k, ¼ W; R3 – 47k, ¼ W; R4 – 330k, ¼ W.

A quick scan through IC literature resulted in the following preamp. They don't get much simpler. The original version used miniature pots for symmetry and gain adjusts and wouldn't fit into the Micoder case. It also generated hum. The second version dispensed with the pots in lieu of fixed resistors, eliminated the hum, and is set for adequate gain for the 2036 application.

Tantalum capacitors and quarter-Watt resistors are recommended, since they form a very compact unit. All wiring is lead to lead (dead bug). Circuit ground is the case of the 741 IC metal case. In this case, you will probably find that the case is internally grounded to V-, so you won't have to make the connection externally. If you use a DIP-style IC, use whatever pin is V- as circuit ground. Use thin shielded lead, such as the type used in phonograph tone arms, for the input and output leads. It is very flexible and easy to work with. You'll pick up hum if you don't use the shielded lead. Strive for the smallest resultant package. After you have tested the unit, either in the mike or using some convenient audio amp, pot the entire module in

a blob of 5-minute quick-setting epoxy. The unit will be insulated and physically protected, and you will prevent shorts between components or to the Micoder terminals.

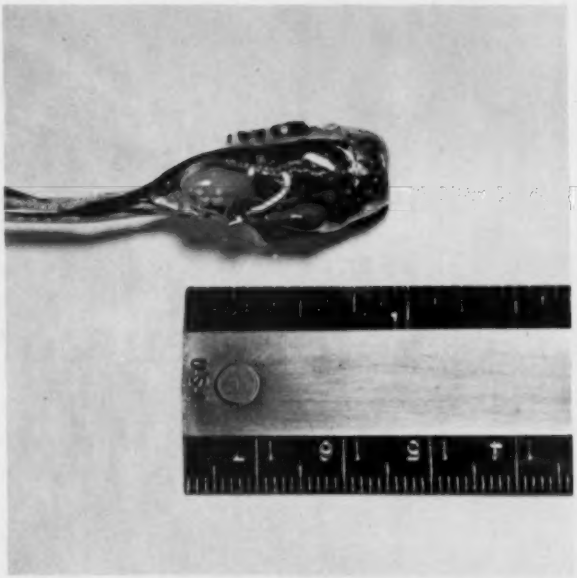
Installation in the Micoder is simple. Disassemble the Micoder case, and set the touchtone generating board aside. Remove the 9 V battery because you will zap the push-to-talk input transistor in the HW-2036 if you accidentally get 9 V on the push-to-talk line. All you need do is short the two middle lugs on the PTT switch. I did. Disconnect the 2.2k, ¼-Watt resistor from pin 2 of the mike element. Connect the preamp input lead center conductor to pin 2 and the shield to pin 3. Connect the 9 V supply lead to SW-101, lug 4. Connect the ground lead to terminal strip D, lug 1. Connect the output lead center conductor to the end of the 2.2k resistor previously disconnected from lug 2 of the mike. Let the shield float. Cram the preamp against and under terminal strip D, and glue it down. Reinstall the battery, and reassemble the Micoder case.

The preamp is set for a voltage gain of about 8 (gain = [R4 + R3]/R3).

The gain can be adjusted (before potting) by varying R4. Decrease R4 to decrease gain and vice versa. With R4 set at 1 meg, you'll realize a gain of about 22, or an output of about 660 mV for 30 mV in.

While thrown together for the Micoder, this preamp should be applicable to any other low-level mike. Just supply a source of 9 V or less. High-level mikes, such as crystal or certain ceramic types, will overdrive this preamp. Also, there is no reason why you can't mount it inside the rig to more conveniently access a source of voltage.

You probably never drove your FM transceiver into the proper speech clipping mode if your mike output was previously inadequate. You now will and with the mike at quite reasonable distances from your mouth. Be prepared to reduce the deviation limiting control on the rig or face the wrath of the local rabble. ■



Example of construction. This unit was constructed using ½-Watt resistors and is larger than necessary.

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Forbidden Contacts

—19 countries off limits to 4X4 amateurs

I found the house of Ricky Kline 4X4NJ as one might expect. I told some of his neighbors in Gan Yavne, a removed little town to the south of Tel Aviv, that I was looking for the amateur radio operator. When that did not bring directions, I added that I was sure that he had a giant antenna on his house. "Oh, that one," responded my informants, and within minutes I was at Ricky's gate.

He showed me into his large attractive split-level house while the 1 dog I had read about at the front gate made his presence known from somewhere in the backyard. We sat briefly in the sunken living room and then climbed past two more immaculate floors and finally reached his shack. Towering bookcases with the stacked books forming random geometric patterns, jumbled equipment, and three large cardboard boxes stashed in a corner with QSL cards slipping out formed a hurricane-like periphery to his orderly and sophisticated station in the center.

I, formerly WA2JPN and looking in on the Israeli amateur scene, asked to see what was happening on the 4X4 net, the 20 meter meeting place for those wanting to make contact with Israeli stations. There were no local contacts in progress. Afterwards, I recalled being told that activity stops almost completely from 8:00, when Arab language broadcasting on the television ends, until 9:30, the end of the news.

"We must act to topple the artificial walls in the ether waves," wrote Ricky Kline 4X4NJ, in the IARC's magazine, The Wave, *as he called for a cancellation of the ban on contact with Arab countries.*

While fruitlessly looking for local hams on the band, Ricky, eight years in the country and K7NJ during his visits home, came across an Algerian station. "Watch this. He won't answer." Sure enough, the 7X2 station was suddenly silent after Ricky's call. "That's typical," he said. "He probably has some clerk in his country who forbids him to." Ricky next tried a CN8 station, who tacked on to his call with precise diction that he was "broadcasting from the Kingdom of Morocco," and met with the same reception.

The next time that Ricky renews his license, some clerk will make it illegal for him, also, to try to bridge the gap between himself and his North African counterparts. The Ministry of Communications recently announced that it was "updating" the current ban on contacts with seven Arab countries to "match the present reality," and that, henceforth, nineteen North African and Middle Eastern states would be off bounds for amateurs. The decision followed the raising of the ban issue some months earlier in *The Wave*, the bimonthly magazine of the Israel Amateur Radio Club, by Rami 4X4LX. After reviewing the question of the ban in general terms, he closed his letter by suggesting that "the club act to have the Ministry of Communications erase this restriction from the terms of the license, quietly and without a lot of fanfare. This does not mean that immediately upon removal of the limitation we have to court the Arab hams, for they certainly will not respond. Removal of the restriction will prove that

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we are not hatemongers."

The following month, the normally bland letters column of *The Wave*, which is published in Hebrew, came alive with a universally favorable response to Rami's suggestion. Erez 4Z4QE stated that "contact between us and Arab amateurs can only be a positive factor on the road to peace." His sentiment was echoed in stronger language by Ricky 4X4NJ, who wrote, "We must act to topple the artificial walls in the ether waves. Amateur radio is based upon friendship, help, and cooperation – principles which are in accordance with the 'open bridges' policy of the government of Israel ... There is no justifiable reason for the existence of the ban today."

Ricky went on to fantasize a conversation between "Hussein" and "Yitzhak" which closed, "'4X1 this is JY1. Yitzhak, you have a nice signal. My name is Hussein. I've been waiting to talk to you for a long time. This is indeed a pleasure – over.'

"'JY1, this is 4X1. Hussein, it is a pleasure for me, too. It's wonderful meeting you this way ...'"

The decision was announced several months later in a letter from the Ministry of Communications printed in *The Wave*. It drew disappointed notice from Doron Arad 4Z4BR, editor of the organ. "The new ban on Arab states, as published in this issue, will certainly set up a far-reaching repercussion amongst us, and we hope that this sad order will be canceled. Just a short time ago, many members spoke of canceling the ban on the seven original Arab countries, and now they have 'generously' added more."

The Ministry of Communications, explained M. Shaked from the section which was responsible for the handling of amateur affairs, was only acting in accordance with instructions that it received from the Ministry of state his personal opinion, Shaked implied that he was in favor of the amateurs' position.

Although the notion of the ban being justified for security reasons was termed "ludicrous" by the amateurs, the decision to broaden the ban was apparently made at a high level in the Ministry of Security – "probably by misinformed people who mean well," noted Ricky. He said that there were presently efforts being made through "quiet diplomacy" to have the decision rescinded. "We don't want to force anyone to make a case they can't back out of."

In spite of the ban, contacts with Arab countries take place. They usually occur during contests and are of short duration. One of Israel's most competent hams, who proudly displayed an aging QSL from Jordan on his wall, worriedly requested to remain anonymous. The ban is taken quite seriously by the amateurs, and there was a great hesitancy to confirm the existence of such contacts. The Ministry of

Secretary of the IARC, David Ben-Basat 4X4WH, places a call on a telephone, with a memory dialing circuit and loudspeaker produced by his electronics firm. He felt that "there is not another country that compares with us in the friendship among Israel's fraternity."

Israel Kass 4Z4IK stands outside the Tel Aviv showrooms of his Volvo distributorship. Israel is the president of the IARC and has his staff take care of much of the club's bulk work, such as

Communications is ready to enforce the ban with a violation report, three of which lead to license revocation.

Russian amateurs are forbidden by their government to talk with Israeli amateurs, a situation which the secretary of the IARC, David Ben-Basat 4X4WH, indignantly termed "a real scandal, for we are not in a state of war with them." There are, however, Russian amateurs who are willing to risk reprisals from the authorities and make contact with Israelis. Ricky 4X4NJ showed me a letter he received from a young Russian amateur with whom he had talked. "Band conditions here are very bad," read part of the letter, "especially on 40 and 20 meters because of jamming broadcast stations a mile away from us." Many such venturesome amateurs are Jews who have been sent to Siberia. One such amateur used to contact Israel every day for months on 20 meters. Suddenly, he disappeared from the air, and it was assumed that the authorities had finally caught up with him. Several months later, he surfaced in Israel as a new immigrant, and, soon after, he received his 4X4 callsign.

Generally, there is mutual cooperation and respect between Israeli amateurs and the Ministry of Communications. Israelis have a high degree of sensitivity to the concept of things being "good for the country" and amateur radio is so considered. Both from the IARC and the Ministry of Communications, I heard the identically expressed sentiment that the measuring rod for the level of technological development of a country is its relative number of amateur radio operators.

Licensing examinations are given twice a year. The Ministry allows an observer from the IARC to sit in on the tests for each of the three license levels. The observers check the questions on the exams, and, if something appears unclear, they ask the examiner to explain the question more completely. On occasion, a question is removed from the examination if it is pointed out as unsuitable.

The lowest level of license, class C, is presently held by eighty amateurs. Operation is severely restricted, with an output of ten Watts allowed and transmission confined to CW on portions of the 15 and 40 meter bands. However, the license is renewable. The class B license is held by 300 amateurs and permits 200-Watt output transmission on slightly more frequencies than the American General class license. The highest class license, class A, is obtained after a code test and a demanding verbal theory test that causes a high rate of failure each time the test is given. One hundred and eighty Israeli amateurs hold class A licenses.

The Ministry of Communications is strikingly cooperative with tourists and new immigrants. Tourists from one of the six countries with whom Israel has a reciprocal licensing agreement, including the United States, who arrive at the Ministry's office with all the required information, are granted a temporary license on the spot. Tourists who arrive from most other friendly countries receive the grants may have a wait of several weeks before receiving their permanent new call. I remarked to David 4X4WH that, in the United States, the process is more complex. "You're telling me!" he exploded and pulled out a carefully worded request that he had sent to the FCC far in advance of his intended trip to the States, and, several days before setting out, he was still unsure if he would receive a positive response.

The Ministry of Communications provides another "extra" to the amateurs by channeling surplus equipment to them through the IARC. The army and police are large sources for such equipment, as in Motorola of Israel. The equipment is distributed by the IARC to its members through raffles. Much of such equipment is dated two meter equipment.

The first shipment of surplus equipment was received in late 1972 and consisted of one-Watt walkie-talkie police radios. Their distribution served to open up the two meter band in Israel, a movement that has continued until today when virtually all eligible hams have two meter capability, and the band has assumed the character of the local corner meeting place. It provided an easy way for making domestic contacts, a capability that served to unite the amateur fraternity in the country. The operating practice of many of the hams on the band, however, draws comparisons to the notoriously bad traffic on the highways.

Two meters has also become the focal point of local development work. There are several groups that meet regularly and work on modification plans or the design for some new component, and there is hardly an issue of *The Wave* that does not appear with some of the fruits of their labor.

The IARC has actively participated in the development of the band by

Ozzie Osrin 4X4CW received his call in 1948 and is the holder of the first amateur radio license issued by Israel. He recently founded an old-timers' club and hopes to enlist eligible

repeaters scattered throughout the country, from Beer Sheva in the south to Safed in the north. The coastal repeaters at Haifa and Tel Aviv have opened them up to two meter DX. With favorable conditions, Cyprus can be contacted.

Most of Israel's active hams, and some who are not, are members of the IARC, according to the club's president Israel Kass 4Z4IK. Their ranks are swelled by 100 SWLs, often youngsters who are in the process of studying for their licenses. The club members meet each other in person at the annual meeting, which is attended by virtually all of the members. The close-knit fraternity, most of whom know each other, also gathers for field days sponsored by the club.

Israel Kass enlists the services of his Volvo distributorship to aid in the distribution of the club's bimonthly magazine, *The Wave*. When the magazines arrive from the printers, he sets the entire staff to work stuffing them into envelopes and attaching computer-printed postal stickers, an operation that lasts several hours. He will also soon add Kenwood amateur equipment to his posh Tel Aviv showrooms, establishing one of the very few organized distributorships of amateur equipment in Israel.

Amateurs generally have to rely on friends coming from abroad or business trips which have taken them out of the country in order to obtain equipment. A thirty-percent tax is levied on amateur gear being brought into the country, which, steep as it may sound, is in sharp contrast to the usual two-hundred-percent tax on electronic equipment.

Friends are also used to circumvent the difficulties in obtaining equipment. There is a tremendous willingness among the Israeli amateurs to help one another, and a great amount of equipment is lent or just given as an outright gift. "When I go out and take something from somebody, I do it because I feel better, not because I can't buy it," explained David 4X4WH. "A friend will hear that I want to buy a certain piece of equipment and he'll say, 'Why waste good money? Come over to my place and I'll give it to you.' " He pointed out his teleprinter as a gift he received, while he himself had lent out thousands of dollars of equipment before leaving on an extended trip abroad.

There are two primary sources of Israeli amateur radio operators. Many are high school students studying in technical programs. They join one of the many clubs (one hundred clubs have valid licenses, although not all are active), and, by the time they are in the tenth grade, they have the theoretical knowledge to pass the licensing test. Even the most critical observer of the Israeli ham scene had words of praise for the level of technical knowledge among such youths. Many other amateurs join the ranks after serving in the army's communication corps. The

"Do you want to learn Morse? To learn international wireless procedures?" asks the Youth Center poster. The announcement was posted by brother and sister, Oded 4Z4RL and Irit 4Z4UE in the family's shoe store in North Tel Aviv.

Numero Uno — the lively meeting place of Israeli and foreign hams just off the bustling Dizengoff Circle in Tel Aviv. In the background, visiting Maurice Kiek PA0CI and Jack Izhaki 4X4AH are seated at Jack's habitual table.

army fosters the hobby and sponsors several clubs that have stations and offer instruction for passing the licensing tests.

Israeli amateurs may be contacted via the 4X4 net. The net, located at 14.320 MHz, grew out of the consistent contact between Hal Crystal K2BYB and 4X4 amateurs. Hal also formed a group of Jewish amateurs called Chaverim ("friends," in Hebrew), which has as its aim, according to its monthly newsletter, "to promote a closer association between Jewish amateur radio operators the world over." While most members of the group must pay a five-dollar subscription fee in order to receive the newsletter, all members of the IARC receive it free of charge. The newsletter is mailed bulk to Israel 4X4IK, who simply has his staff include it in his mailings of *The Wave*.

Amateurs coming to Israel for a visit also have a fixed place where they can meet up with Israeli amateurs. In the center of Tel Aviv, just off Dizengoff Circle, Jack Izhaki 4X4AH has set up an unofficial reception center in a sidewalk cafe called Numero Uno. Taking regularly scheduled breaks from his nearby electronics store, he stations himself at what he calls "my reserved table," just off the sidewalk, and, almost daily, is joined by amateurs visiting from abroad.

The cafe is usually only the starting point of the tour, as Jack often invites his guests home or puts them in touch with other amateurs in the area. Aided by the liberal rules concerning tourist operation and the hospitality of the hosts, the visits are usually quite successful, as warmly confirmed by Maurice Kiek PAØCI as he chatted with Jack at the cafe. "Words can't describe my reception here," he said. "I feel like the prince of the royal family." ■

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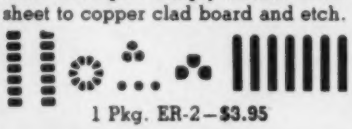

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SR-150 Xcvr	259
SR-160 Xcvr	159
SX-146 Receiver	175
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SX-111 Receiver	149
SX-122 Receiver	249
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HQ-110 A VHF Receiver	$189
HQ-110C Receiver	119
HQ-110AC Receiver	149
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HQ-170C Receiver	159
HQ-180 Receiver	379
HQ-215 Receiver	259
SP-600 Receiver	179
HX-50 Transmitter	169

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SB-301 Receiver	229
HR-10-B Receiver	69
SB-303 Receiver	269
SB-200 Linear Amp	449
SB-102 Trivcvr	379
DX-60B Transmitter	69
HW-32 Transmitter	85
HW-100 Transceiver	249
SB-100 Transceiver	299
SB-401 Transmitter	249
SB-101 Transceiver	349
SB-650 Digital Freq. Display	149
HW-30 Twoer	29
Also Sixer	29
H-10 Monitor	69
VHF-1 Seneca	79
HW-12 Transmitter	75
HP-23 AC Supply	49
HP-23B AC Supply	59
HW-202 2M FM Xcvr	159
SB-620 Spectrum Analyz	130
SB-102 Xcvr	369
SB-610 Scope	95
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SB-634 Console	173
SB-604 Spkr	39.50
SB-644 VFO	129.50
SB-230 Linear	359
SB-104 Transceiver	425

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IC-21 2M FM Xcvr	$299
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IC-30A 432 MCFM	269

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Ranger II Transmitter	139
Valiant I Transmitter	129
Invader 2000 Xmitt	495

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T-599 Transmitter	$289
R-599 Receiver	289
TS-520 Tranc	429
QR-666	259
QR-666 Receiver	239
TV 502 Transvertor	179

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HE-45 Transceiver	49

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NCX-5MK II Transcvr	299
NC-303 Receiver	199
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NCX-500 Transceiver	199
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NC-190 Receiver	149
NC-105 Receiver	69

Regency
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AR-2 2M Amplifier	85
HR-25 2M FM	225
HR-6 Meter FM	189

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SB-144 2M FM	175
SBZ-LP Linear	179

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SRC-146 HT	$149
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SRC-144	295
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700-CX Xcvr	$459
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500 CX Xcvr	389
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14X DC Module	39
MK II Linear	475
KK VI 6 Meter	550
250 C 6M Xcvr	349
FM 2X2M Xcvr	169
FM-1210A 2M	249
350 Transceiver	269
350C Xcvr	299
600R Receiver	339
600T Transmitter	399
410 VFO	79

Tempo
Tempo one Xcvr	$299
AC One Supply	79
FMH 2M H.T.	149
CL-220 Trncur 220 MC	179
FMH 2M w/Talkie	149

Ten Tec
PM-3 Trnsur	$ 49
Argonaut Xcvr	199
KR-40 Keyer	79
RX-10 Receiver	49
S-30 Signalizer	29
Triton II	479

Yaesu
FT-401 Xcvr	$499
FRDX 400SD Rec	325
FT 2 Auto 2M FM	249
FT-101B Xcvr	549
FL-2100B Linear	295
FV-101 VFO	79
101E Xcvr Demo	695

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Tektronix 545A	950
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Bendix BC221 Freq Meter	39
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Precision E-400 Signal Generator	125
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A Darn Good IDer

—repeaters get smarter every day

Did you ever feel that if someone else could do something, then you could, too, and, if not better, then at least in your own way? Ever since putting together a diode matrix CW identifier, I felt there must be a better (or at least different) way of doing things. The area that needed the most attention was programming the call and later changing the program or perhaps just correcting an error made in the "R" of WR5 . . .

So, I sat down with a box of CMOS and decided to do something. The final result is depicted in Fig. 1. I thought of using a shift register first, but the junk box did not have any. All I could find were some memory chips I had been hoarding for a computer project. I tried several memory chips, and an MM2102 1024-bit RAM (Random Access Memory) worked best.

The resulting design is a programmable CW identifier which can hold a varying length message of up to more than 1000 bits. The circuit has the following features: 1) low power, 2) low parts count, 3) variable length message, 4) end-of-message detector, 5) easy programming, 6) easy modification for holding several messages, and 7) can be used as memory in a programmable CW keyer.

The identifier requires a negative-going pulse to start and provides a voltage level out when operating. When the end of message is detected, the IDer stops and resets.

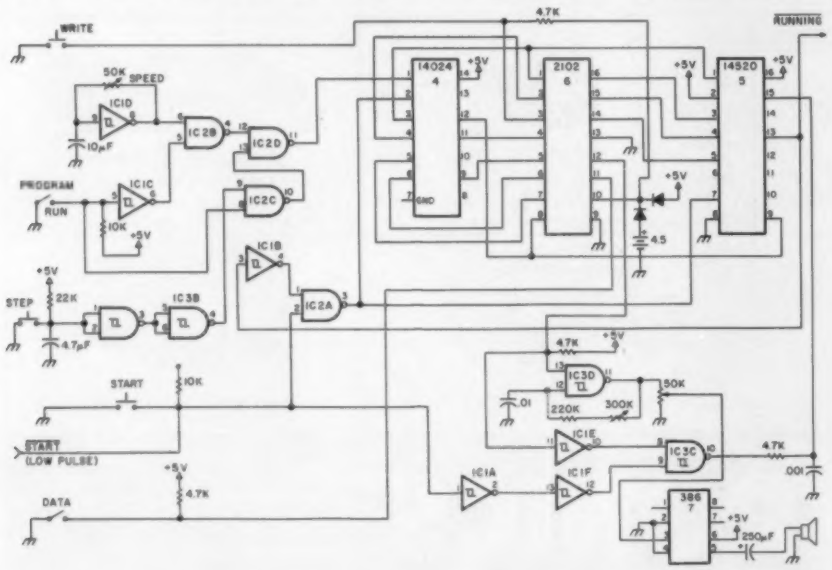

Fig. 1. IC1: MC14584; IC2: MC14011; IC3: MC14093; IC4: MC14024; IC5: MC14520; IC6: MM2102; IC7: LM386.

How Does It Work?

The heart of the system is the clock oscillator. In order to use CMOS wherever possible, I decided to forego the urge to build a simple 555-type clock and instead used a simpler Schmitt trigger inverter. Due to the fact that a Schmitt trigger has a certain voltage at which it detects a logic high and another at which it detects a logic low, an oscillator can easily be made out of one. Referring to Fig. 2, you can see that as the output switches, the input drifts between these two voltage levels. The rate of drift, or frequency of oscillation, is then determined by the values of the resistor and capacitor. A pot is included to allow changing the clock speed. This oscillator is fed into a series of gates used to select either the free-running

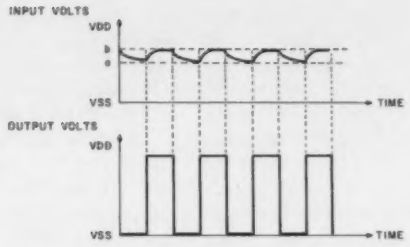

Fig. 2. Diagram of input and output waveforms on Schmitt trigger oscillator. Voltage a is the point where the inverter output goes high, while b is where the output goes low. This is a characteristic of all Schmitt triggers and is called hysteresis.

clock or a pulse from a one-shot triggered by a button on the front panel.

The one-shot is also made from a Schmitt trigger. In this case, the input normally sits high. The button discharges the capacitor and causes the output to go high. As the capacitor slowly recharges through the resistor, the output will eventually switch back to low. Thus a single pulse is generated, and its length is determined by the values of R and C. Also note that as long as the button is held down, the output stays high, so the length of the pulse is the length of time the button is down plus the time provided by R and C. Another reason to use a Schmitt trigger in this application is that the input does not have an active or linear region. In most ordinary CMOS gates, as the inputs slowly drift from high to low, or vice versa, a point will be reached when the output will try to be high and low at the same time. Nearly all current drawn by CMOS logic occurs during this output transition, so it is best to make the inputs go from high to low or low to high as fast as possible (unless you are using a Schmitt trigger).

The pulse from the one-shot is used during programming to step through the memory. The low order (least significant) address bits are generated by an MC14024B (IC4) 7-stage binary counter. This provides the first seven address lines to the 2102 memory. The remaining three come from one half of an MC14520B (IC5) dual binary counter. The other half of the counter is used to generate the stop/reset signal. I considered some type of bit pattern as a stop signal, but that is much too complex to decode. I also thought of a retriggerable one-shot which would time out after the last "1" had been clocked out of the memory. Such an approach would be easy to implement, since a one-shot could be available on another Schmitt trigger IC, but, as code speed is increased, the number of "0" bits needed to fill the time until the one-shot times out increases. Certain indecision then arises at programming time and complicates the task. So, the MC14520 divider was chosen.

The divider is set to count clock pulses. Any time 8 clocks go by without a "1" coming from the memory, a stop/reset signal is generated. That way, no matter at what speed the IDer is running, after 8 "0"s are detected, everything stops. "Why?" you ask. The counter is hooked up so that each time a "1" is sent from the memory, the counter is reset. The stop/reset signal is simply the Q2 output of the MC14520, which stays low until the eighth count. Then it goes high and resets IC4 and the other half of IC5. This also stops the reset counter, so the line stays high until reset by the next start pulse. The free-running clock is still on IC4, but the divider will not respond as long as its reset line is being held high.

Fig. 3. This is a sample chart showing how WR5ALM AUS looks on a preloading graph. The Xs at the end are "don't cares," that is, it doesn't matter what is there.

The reset signal doesn't go directly to the address counters, but is sent through a series of NAND gates, which allows the start pulse to reset the end-of-message counter, as well. This allows the operator to reset the memory to location 0 (the beginning) during programming.

The memory itself (IC6), as mentioned earlier, is an MM2102 MOS static RAM. The data-out line is tied to one input of a NAND gate Schmitt trigger oscillator (IC3D). Thus a zero (or low) level from the memory keeps the oscillator from operating. A "1" (or high) from the memory starts the tone, and it will continue as long as this voltage is present. This line is also sent through an OR gate, made up of two inverters and a NAND gate, to the reset line of the stop/reset counter, as explained before.

Programming the memory is done by first selecting "program" on the program/run switch. This action disables the free-running oscillator and enables the one-shot. Then the "start" button is pressed to ensure that we are at the first location of the memory. The "step" button is pushed a few times to make sure the message does not start instantly. By starting a message in the first location, the first character will reset the end-of-message counter just as if it were a start pulse, and the IDer will go into a loop, resending the same message.

The step button should be pushed staccato fashion, as the one-shot is not a perfect debouncer, and its time constant is very short. (A debouncer is necessary on this switch, as the CMOS logic is fast enough to respond to the noise generated by this, as well as any mechanical switch.) If the button is pushed slowly, extra clock pulses may be generated, causing you to lose your place in the loading sequence.

By first laying out the message on graph paper (Fig. 3), proceeding with loading is simple. As each memory location (corresponding to each successive square on the graph) is accessed, the proper data must be entered. In some cases, the proper data will be present and you can step on. But, if a one is where a zero should be, or a zero is where a one should be, we must use the "write" button. The write button will deposit whatever data is selected by the "data" button. The data button will normally produce ones, but, by depressing it and then working the write button, a zero will be deposited in memory. When done, be sure there are at least 8 zeros at the end, in order to make the reset logic work.

Options

1024 bits is far more space than nearly all repeater IDers will ever need. By adding two switches and two resistors, you can create 4 pages of memory. Each page will be 256 bits long. 256 bits is still more than most repeaters will need, but it does allow some flexibility, and four IDs can be programmed. The way to do this is to disconnect pin 4 on IC5 from pin 15 on IC6 and pin 5 on IC5 from pin 14 on IC6. Next, put a 4.7k pull-up resistor on pin 14 of IC6 and another on pin 15 of IC6. Now run each line to a separate SPST switch. These switches have 4 combinations of positions: both down, both up, one down and the other up, and the first up and the second down. Each com-

bination corresponds to one of the four pages, and each page may be loaded and used separately.

An optional extra included in this circuit is an audio monitor. For simplicity, I went over to the nearby Radio Shack store and purchased an LM386N 1-Watt audio amp IC. It works very well, but it does load the audio oscillator slightly, and changing the volume level will affect the pitch a little.

Another option is a standby battery for the memory. The solid state memory will forget all it knows if power is removed. The two diodes are included to allow the battery to power only the memory and not the rest of the circuit. The pull-up resistor for the write line is also tied in here to keep a false write pulse from occurring during system power up.

The prototype circuit I built draws about 20 mA in standby. The drain on the memory battery during power off is about 11 mA. (I used a 2102, not a low power 21L02. I don't know what the current requirement will be for a 21L02 in this application.) Without the audio chip, standby current is about 17 mA.

Several of these IDers are in use here in Texas — one locally. A few bugs were found before writing this article. A few problems persisted, but, by trying several different 2102s in the circuit, they went away. We feel that all the problems were related to the bargain 2102s we used. A double-sided, plated-through circuit board will be made available if sufficient interest is generated.

While this article purports this to be an identifier, it could very easily be made into the memory portion of an electronic keyer. But knowing that my way may not be your way, I leave it up to you to take this circuit and use it the best way. ■

Social Events

from page 133

eat; 2:30 pm—drawing. Tickets are $2.00 in advance, $2.50 at the door. For information and tickets, write James H. Little WD0BPG, 405 East Rosehill, Marshall, Missouri 65340. Talk-in on 52, 28/88.

MCKEESPORT PA
JUL 23

The Two Rivers Amateur Radio Club of McKeesport PA will hold its 14th annual hamfest on Sunday, July 23, at the Green Valley Volunteer Fire Company grounds in North Versailles, just off Route 30. Talk-in on 22/82. Free parking. Registration required for setup in swap and shop. Home-style food and refreshments. For more info, write to Andrew Salitros W3OFM, 2901 Stewart St., McKeesport PA 15132.

GOLDEN CO
JUL 23

The RMRL picnic will be held at the QTH of WA0HJZ (Rt. 6) on July 23, starting at noon. Please bring food, swapping goodies, and the kids. Talk-in on 34/94. For further info, contact Charles Kaufman WA0GUN, 3734 South Poplar St., Denver CO 80237.

SALEM OH
JUL 23

The Kent State Salem Amateur Radio Club will hold a hamfest on July 23, 1978. The door prize will be a Ten-Tec #540 transceiver, courtesy of KenMar Industries; there will be many others for the whole family as well as a hot air balloon, a ramp for wheel chairs, and plenty of free parking. Wives and kids under 12 free. XYL drawing and recreation facilities available on beautiful campus. Open at 9 am; main drawing at 3 pm. Admission: $2.00; flea market: $1.00; tables: $5.00. Talk-in on 146.10-.70. For information, write W8JPG 147.27, Milhoan Electronics, 1128 West State Street, Salem OH 44460; (216)-337-9275.

INDIANAPOLIS IN
JUL 26

The IEEE Computer Society of Central Indiana and the Central Indiana section of IEEE will sponsor the third annual Indy Microcomputer Show on Wednesday, July 26, 1978, from 11:00 am to 9:00 pm at the Holiday Inn located at I-70 and Shadeland Avenue in Indianapolis. There will be exhibits, demonstrations, and technical seminars addressing the engineering, industrial, scientific, business, and personal applications of microcomputer systems.

OKLAHOMA CITY OK
JUL 28-30

Central Oklahoma Radio Amateurs will present Ham Holiday '78 on July 28, 29, and 30, in the Lincoln Plaza Forum, 4345 North Lincoln Boulevard, Oklahoma City. Preregistration closes July 14 with a fee of $3.00; $4.00 at the door. Noncommercial flea market tables are free in the ten-thousand-square-foot flea market area. Commercial exhibitors contact K5MB at (405)-787-9545 or 787-9292. Technical programs are scheduled throughout the hamfest. Many prizes will be given away, including a special preregistration prize. Mail preregistrations to Ham Holiday '78, PO Box 14604, Oklahoma City OK 73113.

FT TUTHILL AZ
JUL 28-30

The Amateur Radio Council of Arizona will present the annual Ft. Tuthill Hamfest on July 28, 29, and 30, 1978. Come on out in the cool pine country of Arizona, and join our western barbeque, prize drawings, and tech sessions. For further details or preregistration forms, contact PO Box 11642, Phoenix AZ 85061.

KINGSFORD MI
JUL 29-30

The 30th annual U.P. hamfest, cosponsored by the Great Northern Repeater Association and the Mich-A-Con ARC of Iron Mountain-Kingsford, Michigan, will be held on Saturday, July 29, and Sunday, July 30, 1978, at the Dickinson County Armory on M-95 in Kingsford, Michigan. Registration will begin at 9:00 am on both days. Tickets are $2.50 in advance and $3.00 at the door. Saturday night banquet tickets are $6.50, and reservations should be received by July 1. Daily activities include: U.P. net meeting, U.P.R.A. meeting, YL net meeting, ARRL directors' meeting, computers, DX and contests, slow scan, satellite, RTTY, moonbounce, FAX, 2m SSB, a swap and shop, and a special discussion on "Antennas—Legal Aspects" by George Goldstone W8AP, vice-director of the Great Lakes Division. Planned family activities will be held both days. Plenty of parking is available. Prizes galore! Talk-in on 146.25/.85 and 3922. For information, write UPHAMFEST 78, Box 2056, Kingsford, Michigan 49801.

BALTIMORE MD
JUL 30

The Baltimore Radio Amateur Television Society will hold its annual Maryland hamfest on Sunday, July 30, 1978, from 8 am to 4 pm at the Howard County Fairgrounds off Interstate 70, 12 miles west of I-695 (exit 16). Talk-in on 146.52 MHz, and on 63/03, 16/76, and 52.76/52.525. Admission is $2 in advance and $4 at the door. Tailgating space is $2. There will be door prizes, and refreshments will be available. ATV and computers will be demonstrated. Checks should be made payable to the club. For table reservations or further information, contact Mayer Zimmerman W3GXK, c/o BRATS, PO Box 5915, Baltimore, Maryland 21208.

HOUSTON TX
AUG 4-6

On August 4, 5, and 6, 1978, the Houston Echo Society will host the annual Texas VHF-FM Society Summer Convention in the Galleria Plaza Hotel, just off interstate loop 610 at Westheimer Rd. While primarily devoted to the VHF-FM spectrum, attractions will also include microprocessors/microcomputers, the annual Texas champion hidden transmitter hunt, OSCAR communications, and much more, covering all phases of amateur radio. There will be forums conducted by both the ARRL and the FCC. A banquet/dance is planned for Saturday night. The featured speaker will be William A. Tynan W3XO, editor of "The World Above 50 MHz" column in *QST*. Exhibitors will be displaying their wares all day Saturday and Sunday. Several excellent prizes will also be given away. The main prize will be the choice of an HF rig or an allmode VHF rig, with the second prize being the rig which is not given away as the main prize. There will also be a preregistration prize as well as hourly door prizes. More information can be obtained by writing to: FM Society Summer Convention, PO Box 717, Tomball, Texas 77375.

MACKS INN ID
AUG 4-6

The 46th Annual WIMU (Wyoming, Idaho, Montana,

Continued on page 214

SCR 1000 - Standard of Comparison

In Repeaters - Now Available with Autopatch!

Autopatch Features:

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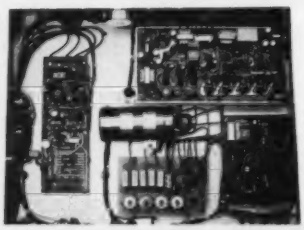

Under chassis view of SCR1000 with Autopatch installed.

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—*ultra-flexible crystal calibrator*

While making the rounds at the Dayton Hamvention, pockets lined with moderate amounts of ready cash for those once-in-a-lifetime good deals, I came upon a very unique crystal calibrator manufactured and sold by Rainbow Industries (P.O. Box 2366, Indianapolis IN 46206), which was on display and available for immediate sale. Being presold on the unit, having previously read an advertisement extolling its virtues, I grabbed one for the W8FX/4 shack.

What makes the Rainbow FS-200 calibrator so different from the usual circuit providing calibration markers down to every 1000, 100, and sometimes 25 or 10 kHz is that it does all this and goes much further. It provides strong switch-selected, square wave markers every 1 MHz, 500, 250, 100, 50, 25, 10, 5, 2.5, and 1 kHz, as well as every 500, 250, 100, 50, and 25 Hertz! Thus, it can be used for a number of additional applications, such as an oscilloscope timebase calibrator, audio generator, frequency counter timebase, accurate signal source for analog and digital projects, hi-fi response testing, and, yes, even code practice. It features CMOS (complementary metal oxide semiconductor) integrated circuitry, constructed on a 3¼" x 2½" board, and has a trimmer capacitor for precise frequency adjustment. It will operate on any power source from 6.5 V dc to 15 V dc at about 15 mA. A front-panel BNC connector is provided for connecting to the output stage directly or for using a short piece of wire as an "antenna." Desired output frequency is switch-selectable from the front-panel "range" and "multiplier" switches.

The calibrator is available either fully wired and tested (Model FS-200C, for $34.95) in a minibox enclosure or as a prewired printed circuit board (Model FS-200B, for $19.95) less controls, switch, connectors, and cabinet. I bought one of the fully-assembled units and, upon hooking it up to a 9-volt battery, was pleasantly surprised to discover that it worked just as advertised, providing strong markers at practically any desired internal frequency well into the VHF region (over 100 MHz for my unit). The unit was easily calibrated against WWV by adjustment of a trimmer capacitor on the PC board. You could also calibrate and cross-check against a frequency counter of known accuracy. If you calibrate by zero-beating against WWV,

it's best to use the highest frequency receivable so that you would be using a high-order harmonic of the basic oscillator in the calibrator, for highest accuracy. One point to remember is that, as you approach zero-beat, the audio "beat note" becomes lower and lower, so it may be difficult to detect true zero-beat. Try using the receiver's S-meter; it will usually try to "track" the swing through zero-beat and can generally be relied on to get down to within a few cycles accuracy.

The fact that the FS-200 can produce markers down to 25 Hz suggests other uses for it — perhaps as an oscilloscope calibrator/timebase and audio signal generator. By interrupting its supply voltage, it could even be used as a code practice oscillator (making an interesting initial dual investment for the serious SWL who's about to become a Novice).

As fine an instrument as the FS-200 is, it did present a minor problem. It was another little convenience gadget for the shack that needed another 9-volt transistor radio battery. Though they're inexpensive and easily available free at Radio Shack (using their "Battery Club" card, of course), each time one poops out, I have to open up the cabinet and replace the battery, a slightly inconvenient task when done repeatedly. The addition of the FS-200 brought into focus the need for a small "cheapie" power supply, providing a source of multiple low-voltage outputs. The FS-200 could provide the "piggyback" vehicle for it, along with some simple interface circuitry for the calibrator. The only modifications required on the calibrator were mounting two rear-apron miniature phone jacks (external power and key), running leads to the battery clips, and mounting an RCA phono jack on the rear apron for rf output (wired in parallel with the front-panel BNC jack). Be sure to remove the PC board while drilling to prevent possible damage to the components.

The circuit in Fig. 1 is what evolved. Mounted in a 3-1/4" x 2-3/16" x 4" minibox (Radio Shack #270-251 or equivalent) and connected to the FS-200 by a short length of cable, it provides interface circuitry for the calibrator and a means of low-voltage power distribution. The circuit provides direct receiver rf output coupling for the FS-200, a small antenna or auxiliary rf output, and adjustable rf and audio outputs. Also provided are nonregulated 6- and 12-volt outputs, as well as regulated 9-volt outputs to power various and sundry gadgets; regulated power for the FS-200 is simply routed back to it through a short length of cable. Using a closed-circuit jack on the FS-200 rear apron allows internal 9-volt battery operation when external power is removed. An LED provides power-on indication for the interface/distribution box. Wiring follows conventional point-to-point practice.

The power source used for the unit is simple. I located two junk box ac adapters (battery eliminators). One provides about 12 V dc (no load) at 300 mA, and the other supplies about 6.2 V dc at 300 mA. The 12-, 9-, and 6-volt circuits are kept separate to keep interaction down and regulation simple. Zener diodes in the 9-volt circuit provide a small degree of voltage regulation. Though the output of the battery eliminator (ac adapter) doesn't have enough real current reserve for good regulation under heavy loads, it can easily power most of the small low-current accessory devices which require four penlight cells or 9-volt transistor radio batteries as power sources. A 9-volt adapter can be used if a 12-volt unit can't be located, with the dropping resistor values changed accordingly. Voltage regulation would, of course, be minimal. No attempt was made to regulate the 6-volt circuit, though this could be done if necessary for your purposes.

In any case, ensure that the adapters used are not cheapies having a direct connection to the ac line, which would present shock and grounding-out problems. Also, most adapters are not adequately filtered to provide good dc output. High-value electrolytics (1000-3000 uF) across the supply lines will do much to filter out any trace of hum or ripple.

Various types of connectors can be used on the piggyback box for audio, rf, and power connections, whichever meet your needs. I used RCA-type phono jacks for rf (routing the receiver coax antenna lead through the unit for signal injection), RCA-type phone jacks and miniature Amphenol-type mike connectors for audio, and miniature phone jacks for dc

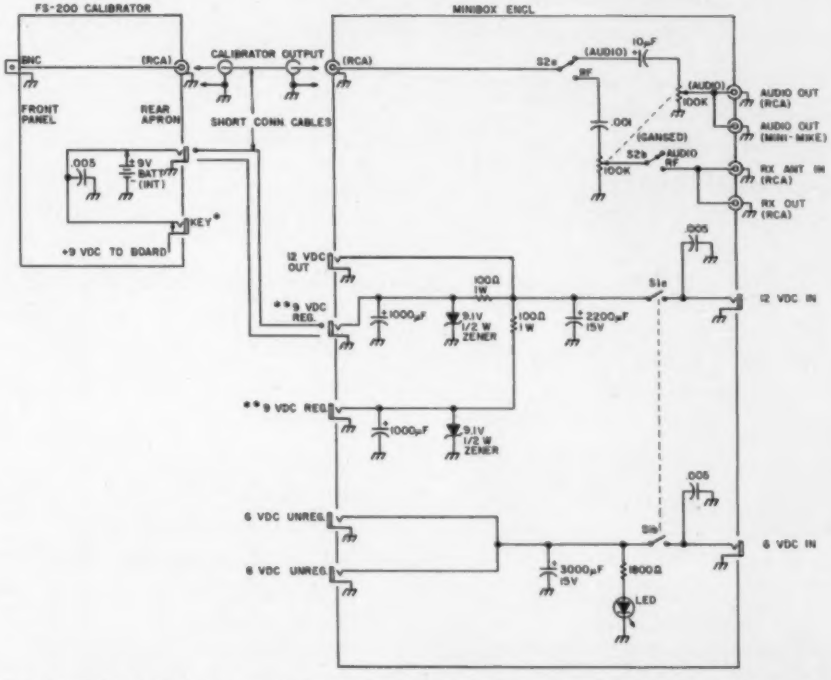

*Fig. 1. Interface diagram. Additional 6-, 9-, and 12-volt outputs may be added as desired. All values are nominal. You may have to experiment with zener and LED dropping resistors for best performance. *Insulated from the chassis (mounted on the plastic rear apron of the FS-200). **Low-current drain (20-30 mA). Use high-wattage zeners and dropping resistors for higher current capacity. Use separate zener circuitry for each regulated device.*

power input and output. (Note that if you use the calibrator with a transceiver, you will have to provide some means of switching it out of the circuit on transmit to prevent transmitter output from damaging the unit. If your transceiver has an "external receiving antenna" input, you can usually route the output there — check your transceiver's schematic first!)

Suggested application notes and circuitry are furnished by the manufacturer or can be found in good texts, such as the ARRL *Radio Amateur's Handbook*, Bill Orr's *Radio Handbook*, and 73's *Radio Frequency Testers* or *Audio Frequency Testers*. These can be consulted for interface ideas for your particular purposes.

For code practice, it's easiest to simply run the rf output directly into the receiver. The FS-200 is acting, in effect, as a mini CW oscillator. The receiver doesn't even need a bfo. By playing around with the "range" and "multiplier" switches, you can come up with MCW (modulated CW). Try it for code practice — it really works.

Don't try to use the piggyback supply for IC circuits requiring good regulation under heavy load; it isn't designed for such use. But, for the multitude of simple projects and gadgets (audio filters, compressors, preamps, signal generators, etc.) requiring but a nominal source of low-voltage dc, it fills a real need at a minimum investment, not tying up an expensive, heavy-duty regulated dc supply. If you don't own an FS-200, try building the power distribution box anyway. You'll find it will interface well with other less versatile calibrators, signal and marker generators, and audio generators, and the power supply will indeed come in very handy when the battery in your speech compressor or keyer fails! ■

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Sometimes A Kit Is Best

—Bullet power supply kit exposed

A. A. Wicks W6SWZ
30646 Rigger Road
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As more and more amateurs upgrade their 2 meter transceivers to 20- to 35-Watt output units, there has been a corresponding increase in interest in higher-current power supplies for base station use of this mobile equipment.

Unless your junk box is stocked with late-model parts, it is usually necessary to purchase expensive components, in addition to designing or researching a proven supply circuit. The job of assembling a suitable power supply has been simplified by some firms offering kits of parts, but in only a few instances have these suppliers come up with adequate kits for the higher current needs with amateur transmitter applications in mind.

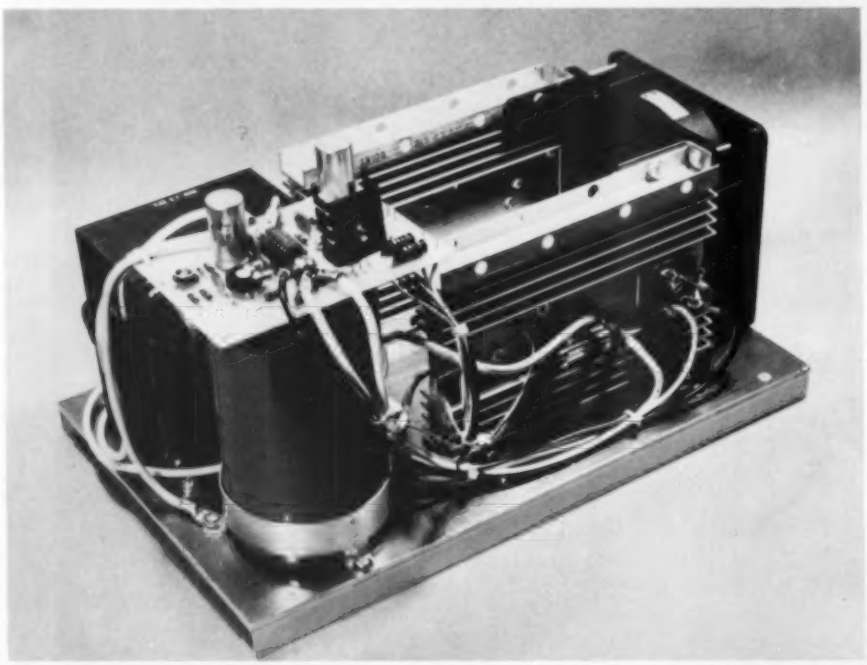
Aware of this problem, Bullet Electronics is now offering a new kit which meets the essential needs of tested design, quality parts, and low cost. In fact, I was amazed, upon receiving this very complete kit, to see the careful attention that has been given to the preparation of it – especially as it would benefit the person who has few facilities at his disposal. As an example, even the mica insulators for the power transistors are supplied precoated with silicone grease and in leakproof envelopes. This, at first, caused me to think that the insulators were missing and that the envelopes contained only compound; however, I was happy to discover that all of the "dirty work" had also been done for me.

Nothing, including miscellaneous hardware, has been omitted from the kit. But the user must provide his own chassis (which may be anything from a board to a chassis-cabinet combination) and any optional items which may enhance the user's needs, such as meters, switches, etc.

The electronic parts are premium brand-name units, and, probably as a result of this, Bullet provides a 90-day warranty on all of them, including the heavy-duty power transformer. An excellent quality fiberglass printed circuit board is used for all of the control and regulation component circuitry. Plating is smooth and even, and all traces are sharply etched. Bullet has certainly overcome some of the problems in this respect that were evident two years ago.

The technical manual provided with the PS-14 is very complete, comprising 12 pages of theory, parts list, tools required, constructional details, testing information, and a troubleshooting guide. The latter section, contrary to the usual kit manuals, provides not only information regarding difficulties caused by improper assembly, but also extensive information in the event of component failures at some time in the future. Eight line illustrations are included in the manual, as well as one printed circuit board layout drawing and a total schematic containing all necessary test point voltage references. One additional general information sheet provides valuable information to guide the constructor in installing parts (good for any kit), handling integrated circuit devices, soldering techniques, and component color coding.

As will be noted in the



Bullet Electronics PS-14 power supply assembled. All parts shown are supplied with the kit, except the fan and base.

schematic, the heart of this closely-regulated power supply is a type-723 integrated circuit precision voltage regulator. The term "regulated" is really significant here – with 200 millivolts being the variation between no-load and full-load conditions. The 723 is a silicon monolithic device, which can provide voltage regulation at any voltage between 2 and 37 volts. However, this supply is designed to provide voltages between 11.6 and 13.5 volts, specifically. This useful IC includes within its circuitry a temperature-compensated reference amplifier, an error amplifier, a power series transistor, and a current-limiting circuit. In addition, a 723 provides independently accessible inputs for adjustable current limiting and remote shutdown. Low-temperature drift and high-ripple rejection are other features of this device.

Bullet has taken advantage of these attributes and has put it all together in this power supply. Their specifications for the PS-14 power supply are shown in Table 1.

Briefly, the operational theory of this supply is described in the following (refer to Fig. 1).

A reference voltage is obtained at the 723 pin terminal 6, V_{ref}, which is used to provide a stable voltage to the noninverting input, N_i, at pin 5, The latter is an input error amplifier within the IC. R4 and C4 provide noise filtering for this reference voltage.

A voltage divider (R14, R15, R16), permits the inverting input, I_{nv}, pin 4 of the error amplifier, to "look at" some percentage of the output voltage. Variable potentiometer R15 allows the voltage to be adjusted approximately 20%.

The result is that the voltage at I_{nv} matches the voltage at N_i as long as the voltage remains at a constant value. However, should the output voltage commence to increase, the voltage at I_{nv} increases, and the internal drive transistor starts to shut down. In turn, the drive is reduced to the series-pass regulators Q1, Q2, and Q3, thus reducing the output voltage. Conversely, the output voltage will be increased if it has commenced to fall.

Q3, Q1, and Q2, mentioned above, form a Darlington circuit that acts as a single PNP transistor. R6 and R7 assist in controlling current "hogging." C5 prevents the high-gain series pass circuitry from oscillating.

Usually in voltage-regulated supplies that use a 723, the current limiting on the 723 is provided by a resistor in series with the output, which develops 0.65 volts at the desired maximum current. This current switches on the current-limit transistor to reduce the output. Bullet concluded that this would have two disadvantages – one, at 17 Amperes the calculated resistor would be 0.038 Ohms at 12 Watts, which is not exactly your corner-store resistor; two, the total dissipation of the pass transistors would reach 300 Watts in a short-circuit condition. The circuitry selected for the PS-14, then, uses a unique foldback current-limiting design which uses the output fuses as the series current-limit "resistors," with a current adder circuit.

Output voltage:	11.6 to 13.5 dc volts
Output current.	15 Amperes (continuous) 20 Amperes (intermittent)
Current limit:	10-20 Amperes (guaranteed range)
Regulation:	200 millivolts no load to full load
Short-circuit current:	10 Amperes maximum, 3 Amperes typical
Ripple:	Less than 1% at full load
Thermal shutdown:	Variable from ambient temperature to greater than 200° Celsius (392° F)

Table 1.

Once again referring to Fig. 1, note that R5 is across the base-emitter junction of Q3. This provides a fairly constant voltage drop of 0.6 volts. Inversely proportioned to the value of R5, a current flows into V_C (pin 11) of the 723. Additionally, a current that has a value of I_{out} divided by the gain (H_{fe}) of the Q3-Q2-Q1 configuration is present at the base of Q3. Since this total current enters V_C, it will exit via V_O (pin 10) and go into the current-limit transistor at C_j, pin 2.

The component values in the PS-14 allow the current flowing out of V_O to be approximately 25 mA (R5 plus Q3 current). This current then flows into the junction of R10 and R11, causing a voltage to appear across these two resistors. This will make the junction about 0.6 volts greater than V and C_s. Normal turn-on voltage required is 0.65 to 0.7 volts.

As the current increases, the additional voltage drop across fuses F1 and F2 is required to activate the current limit – the closer the

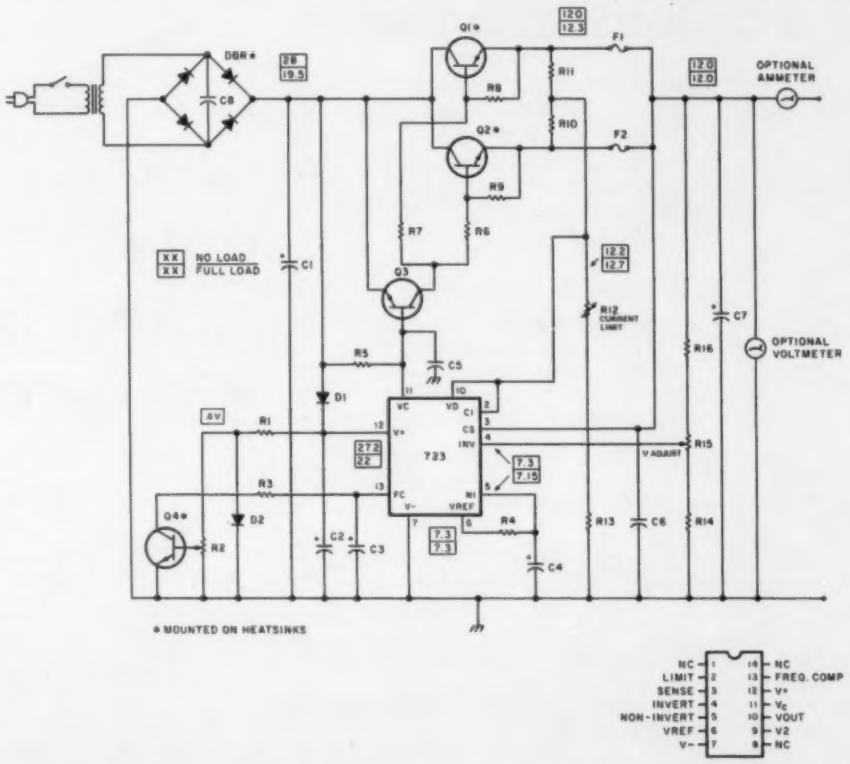


Fig. 1. Schematic of Bullet Electronics' P-14 high-current regulated power supply.

wiper of R12 to R13, the higher the current limit will be.

In addition to the foregoing, R10, R11, R12, and R13 also function as part of the foldback current circuit. A fraction of the output voltage is used to oppose the voltage across the current-limiting fuses and the voltage generated by the circuit described in the preceding paragraph. Current limiting does not occur until the voltage across the sense resistor is higher than this opposing voltage. When the output is shorted to ground, the opposing voltage is no longer present; therefore, current limiting occurs at a lower level.

The thermal shutdown circuitry is standard. Theoretically, the base-to-emitter voltage (V_{be}) of a transistor decreases with temperature. For instance, turn-on for a silicon transistor at room temperature may be about 0.6 volts. As the temperature proximate to the transistor increases, this turn-on value decreases because of electron-hole breakdown. Now the turn-on voltage of the transistor at, let us say, 100° C. (212° F.) may be 0.4 volts.

In this configuration, D2, acting as a zener diode, provides 0.65 volts of regulated voltage to the upper point of potentiometer R2. The latter bias is adjusted below the turn-on point of Q4, for normal ambient temperature. Q4 turns on at approximately 4.8 volts, and this point is reached at 75° C. (167° F.). As Q4 conducts, the 723 at pin 13 shunts current from the base of Q4 via the collector, which in turn causes the 723 to operate, and the output voltage of the supply goes to zero.

Assembly of the power supply was very straightforward and was completed in six hours. Testing took another two hours, but this included some trouble-shooting time because I had inadvertently connected the wires between the circuit board and the thermal shutdown transistor incorrectly. A very minor "operation" is required on the power transformer and takes about five minutes. The transformer was originally manufactured for another purpose, and this modification provides a winding configuration that produces 20 volts ac.

The PCB was a pleasure to assemble, due to the excellent soldering characteristics of the board, as mentioned. In my installation, I included a cooling fan, even though my present requirements will not exceed a 10-Ampere load. But, by building for possible future needs, I was able to do the necessary hardware and packaging at this time. Open-frame construction was used, which permits the aluminum "breadboard," as shown in the photograph, to be installed in a cabinet with a slip-on cover. The "optional meter" positions, as shown on the schematic, will be used with the meters installed on the front panel of the cover, together with switches for ac and the fan. (It would be very simple to arrange it so that the fan starts at some predetermined thermal point.) Incidentally, Bullet has meters available for this power supply, if desired. They also sell an overvoltage-protection kit that is directly compatible with the PS-14. Although not installed at this time, one of these will become part of my PS-14 very shortly, as it is very desirable to limit potentially dangerous voltages to expensive equipment. Incidentally, the PS-14 may also be used as a battery charger – with suitable diode protection, of course.

The PS-14 is priced at $39.95, including UPS charges (foreign orders should add $10 for shipping and insurance). It's available from Bullet Electronics, PO Box 19442H, Dallas TX 75219. ■

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M41

Coming In Out Of the Cold

—power supply for your mobile rig

Henry Olson W6GXN
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One of the largest areas of growth in the amateur radio and CB market in recent years is that of small transceivers for automobile use. Some of these have built-in 117 volt ac supplies, and some have them as options in a separate package. But there are certainly many around which either were never meant to operate on the ac mains or for which the ac supply was not bought at the time of initial purchase and is no longer available.

The regulated supply described here will provide a substitute for your car's +12.6 volt dc battery system for equipment that draws up to 3 Amps. This will enable you to bring the rig in the house and continue operation, if you don't have a separate home station. In fact, such a supply is even worth having around only for those moments when the mobile rig is "sick" and needs repair, so it's on the workbench, in the house. It's also handy when the other types of auto electronics (radios, tape players, etc.) go on the fritz.

The main things that this supply has that many simpler commercial transceiver supplies do not have are good electronically-regulated output and current limiting. The output voltage is adjustable from 11 to 15 volts, so low, normal, and high battery voltages can be simulated. At currents over 3 Amps, the supply drops out of regulation, and no more current can be drawn from it.

The circuit of the supply is shown in Fig. 1. Note that the power transformer (one of the most expensive items in most supplies) is made up of three old filament transformers. This technique is not as neat and compact as having a special transformer that delivers just the right voltage and current for the job, but most hams and experimenters have lots of old transformers around from the tube era. The three transformers, when connected in phase, produce about 15 volts ac, which gives more than +21 volts dc using a full-wave bridge rectifier and capacitor-input filtering.

The regulator is the old reliable National LM305H with 2N4037 and 2N3055 added to increase the current capability. The 2N3055 is still the cheapest high-current silicon power transistor around, and thus it has been chosen here. The 2N3055 must be well heat sink mounted, of course, since, at the worst thermal case (11 volts out at 3 Amps), it must dissipate nearly 20 Watts! For this reason, the 2N3055 has been mounted on a large finned aluminum heat dissipator. Just heat sinking it to the chassis or a small plate for dissipation is probably asking for thermal runaway problems to develop.

The regulator circuitry, excluding the 2N3055, is built on a small PC board which I use as a sort of

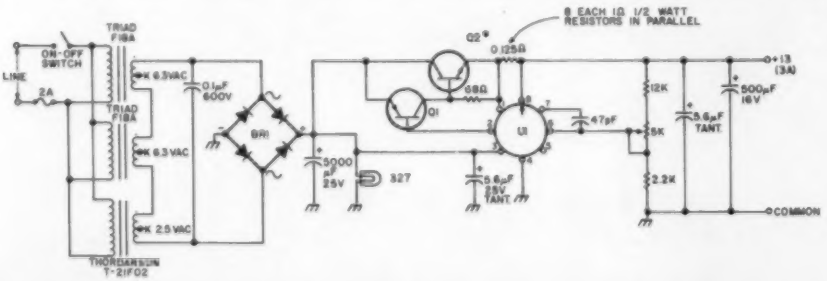

*Fig. 1. Regulated supply for small transceiver (with current limiting). *Heat sink Q2 to adequate finned aluminum dissipator.*

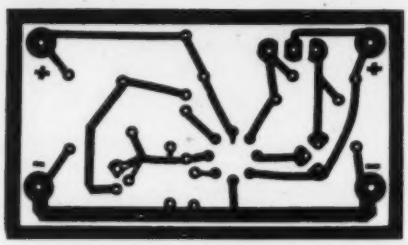

Fig. 2(a). Regulator board.

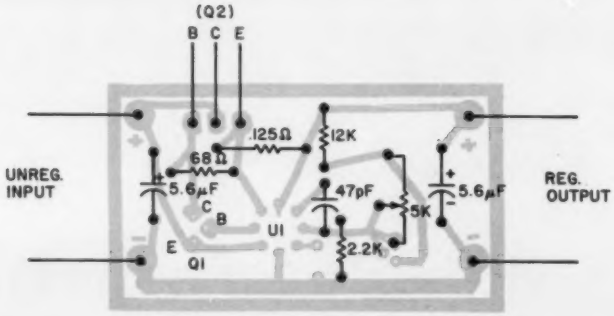

Fig. 2(b). Parts placement.

general purpose regulator card. I have these made up for my own experimental use, at a quantity price, and use them as needed. The layout of this PC board and the parts placement on it are shown in Fig. 2. This board is useful with an NPN-PNP pair of transistors, as in Fig. 1, a single PNP transistor, as in Fig. 3, or with the LM305H alone, as in Fig. 4. These three cases reflect decreasing magnitudes of output current. The details of how to design for the three cases are discussed in detail in references 1, 2, and 3. Note that the PC board is laid out so that a multiturn linear trimpot (such as a Beckman 78PR5K) can be put directly on it. A single-turn trimpot (such as a Beckman 62PR5K) can also be mounted directly on the board. If a standard pot is used off the PC board, care should be taken to mount it only a few inches away to prevent the regulator from becoming unstable.

There is, of course, some flexibility in the types of power transformer you use for this supply. You might use one 6.3-volt and one 10-volt transformer (16.3 V ac total) or one 10-volt and one 5-volt transformer (15 V ac total), but whatever you use, the dc output voltage across the filter capacitor *must not drop below about 17 volts*. By this I mean *absolutely* not below 17 volts, even at the bottom points of the ripple, or the regulator will drop out of regulation.

If you're in doubt as to whether your particular transformer(s) will work, haywire up transformers, bridge rectifier, and filter capacitor and put a resistive 3-Amp load on this rectifier-filter combination. A dc scope on the load should look like Fig. 5, and the minimum voltage, as shown, should not drop below about 17 volts. You ought to consider using one of the older TV power transformers, which have a high current 6.3-volt winding plus a 5-volt winding (usually 3 Amps, to operate a 5U4G), as one source of part of the series ac voltage. The high-voltage windings would be carefully taped up in this usage.

On the semiconductor list, there are a number of substitutes, including the widely-available Motorola HEP types for the discrete components. The one IC originated by National Semiconductor is second-sourced by Advanced Micro Devices, Fairchild, Intersil, Motorola, Raytheon, Silicon General, and Texas Instruments.

The supply was built on a 7" x 9" x 2" aluminum chassis with the three transformers to the rear. The wiring of the ac primary switch and fuse and the wiring of the rectifier-filter section are underneath the chassis. The regulator board and heat sink with the 2N3055 are on top of the chassis (for ease of voltage trimpot adjustment and air convection, respectively). No meters or enclosed cabinet were used in this supply, because they would increase the cost considerably. Judicious choice of meters from surplus emporiums and similar cabinet procurement could allow you to have a nicely-finished bench supply. This detail is, of course, up to the builder. ■

Parts List

BR1	3-Amp bridge rectifier, Motorola MDA970-2 or HEPR0876, or 4 each 1N4720 or HEPR0091 (wired as bridge)
Q1	2N4037 or HEPS3012 (Motorola)
Q2	2N3055, MJE3055, or HEPS7004 (Motorola)
U1	LM305H (National) or MLM305G (Motorola)

References

1. National Semiconductor, *Linear Data Book*, June, 1976, pages 1-7 to 1-11.
2. National Semiconductor, *Voltage Regulator Handbook*, May, 1975.
3. National Semiconductor, *Linear Applications*, Feb., 1973, pages AN-23, LB-7, LB-10.

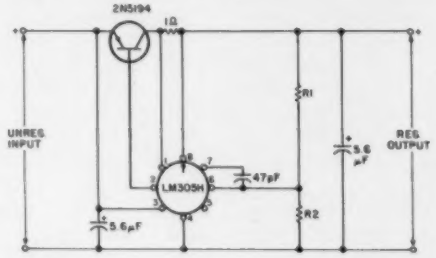

Fig. 3. LM305H with PNP medium-power transistor used as medium-current regulator.

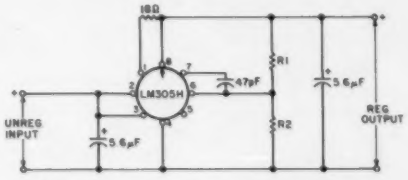

Fig. 4. LM305H without external transistor used as low-current regulator.

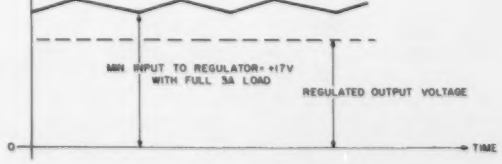

Fig. 5.

Bob Renaud
39 Ontario Street
Pittsfield MA 01201

Roy Rogers Special: Triggered Sweep

—lab scope performance for less than a gigabuck

In any shack, lab, or shop, the most important test instrument is the oscilloscope. However, most scopes used by the home experimenter, unless funded by grants from the Rockefeller Foundation, are the "service" type — not too fast, and cursed with recurrent sweep. For that problem, this article offers a solution.

Before going further, let's look at the two types of sweep used in scopes. The most common is called the "recurrent" sweep and is, when all is said and done, a glorified sawtooth oscillator with provisions for injecting sync pulses to warp its free-running frequency slightly. To achieve a stable display, the input frequency must be equal to or a multiple of the sweep's frequency, and drift in either will result in the familiar swirling miasma of traces.

The "triggered" sweep, used in lab-type scopes, is also a sawtooth-generating circuit, but is not an oscillator. It might be compared to a one-shot, initiated by a pulse that represents a particular point on the input signal. When the sweep is complete, it retraces and waits for the next pulse, however long it might take.

It can be seen, then, that the input frequency or rep rate is irrelevant because the sweep is locked to it at all times, and the display is rock steady. Interestingly, the period of the input may be far longer than the actual sweep, which is impossible with the recurrent sweep.

For digital work, the triggered sweep is just about imperative for any serious observation, and, in any case, it's the way to go. Unfortunately, modifying a service scope's internal circuitry to achieve it is apt to evince the omnipotence of Mr. Murphy's famous law, in spades.

The QD-1 triggered sweep adapter (short for Quick and Dirty) is designed to avoid that hassle. It plugs into the scope's horizontal input jack and uses its X-amplifier to drive the trace. The internal sweep circuits are unaffected.

Offered by this plug-in are such niceties as ac/dc input coupling, selectable slope (rising or falling), trigger point selectable by switch to either ground or a variable level, a very linear ramp, excellent stability, dc-coupled sweep voltage output, a blanking output, and a mini-sized price tag (practically zip if your goodies box is fat and happy).

You won't wind up with a Tektronix or a Hewlett-Packard, but your wallet will thank you.

Circuit Description

The operation of the sweep is straightforward, with no cute little subtleties hidden amongst the resistors. The input signal is coupled via C1 (S1 for dc), through sensitivity pot R1 and resistor R2, to one common of S2. The trigger level signal, either ground or a voltage from level pot R5, is selected by S3 and applied to the other common of S2. When R2 is connected to IC1A, pin 3, the circuit is set to positive slope; it's negative when tied to pin 4.

In either position, when the "+" input becomes more positive than the "-" input, the output of the comparator goes high (note the absence of a pull-up resistor to pin 1; the circuit operates more stably without it), and the one-shot, IC2, pulses. Its $\overline{Q}$ output emits a 25-30-nanosecond negative pulse, which sets latch IC3A, B.

When set, IC3B's output goes low, turning off Q2, Q4, and Q5. In order: Q2 releases the ramp line from ground, and the timing capacitor begins to charge through constant current source Q3; Q4 allows divider R10-R11 to set a 13-volt reference to the "+" input of IC1B; and Q5 collector voltage rises to 15 volts, unblanking the scope.

When the ramp voltage rises sufficiently, it forward biases D1, and the "-" input becomes more positive than the "+" (reverse of IC1A). IC1B's output goes low. This resets the bistable latch and turns on Q2, Q4, and Q5. Again, in order: Q2 shorts out C_T and the sweep voltage plunges toward ground, retracing the sweep; Q4 grounds the reference voltage, the purpose being to assure that the comparator output remains low until the retrace is fully completed (without Q4, as soon as the ramp voltage became less than V_{ref}, the comparator output would go high, making the latch susceptible to retriggering pulses before the sweep has time to retrace, resulting in erratic foreshortened sweeps); and Q5 goes to ground, and the 15-volt negative change, coupled by the scope's Z-axis capacitor, would blank the scope as though the cathode itself were made that much more negative.

Once the ramp-line voltage becomes lower than the forward voltage of D1, with respect to the "+" input, the comparator output goes high, the latch is opened to the next trigger pulse, and the cycle repeats.

The sweep output is coupled via emitter-follower Q1 and is of low enough impedance to resist loading by most scope X-axis inputs.

The 13-volt ramp is more than adequate for full-screen sweeping at a moderate setting of the horizontal gain control.

Miscellaneous Information

The ramp voltage is positive going, and your scope may well trace from right to left as a result. This is cured by a DPDT switch to reverse the CRT's horizontal plates when using the QD-1.

If your scope is not equipped with a Z-axis input, locate the lead tied to the cathode of the CRT and connect it via a .1 microfarad capacitor to a jack for the blanking input. Be sure the capacitor is rated for the cathode voltage, which can reach positively transistor-frying levels.

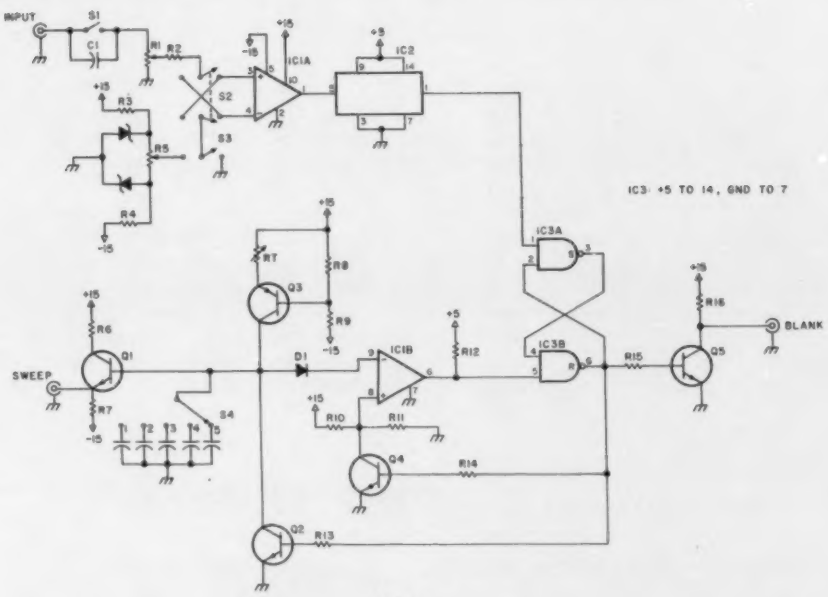

Fig. 1.

On ac-coupled scopes, a lateral drift of the trace will be noticed as the sweep rate or input frequency/period is changed. This is due to the variable duty cycle of the triggered sweep (the ramp is constant, but the rest time varies) and is unavoidable. It's a minor nuisance and can be lived with in view of the superiority of the triggered sweep. Dc-coupled scopes have no such problems, of course.

If the bandwidth of the X-axis amplifier in your scope is limited, you'll notice shortening and distortion of the trace at very fast sweep rates, typically less than about 2 microseconds per centimeter. This is a minor problem, and you'll learn at what point your scope can't hack it any more. Rest assured, though, that your QD-1 is putting out the correct sweep waveform even up at those whiz-bang speeds, as a faster scope will verify.

In ac-coupled scopes, very slow ramp speeds will distort due to the inability of the internal coupling capacitors to pass the signal without differentiating it. If you want to use yours for a medical monitor, get a dc scope and go as slowly as you please.

The value of the timing resistor, R_T, is given as a 220-Ohm resistor plus a 2k pot. If you're of an ambitious bent, you can set up a series of R_T/C_T combinations, each set to a calibrated sweep rate such as found on the better scopes. The values of C_T given in the parts list will cover the usable range that can be passed by the typical service scope.

If you elect to use different voltages than the plus/minus 15 of the schematic, dividers R8-R9 and R10-R11 will require tweaking to establish operating points at the new voltages.

The zener diodes used in the reference circuits for the level pot are from 3 to 5 volts, whatever you have handy. Don't go too much higher, though, because the allowable operating differential voltage between LM319 inputs is ±5 volts. (This is the other function of D1, by the way. It keeps destructive differential voltages off the inputs of IC1B.)

Construction can be by any suitable technique. I used wire-wrapping for ease of modification and assembly, but, if you wish to whip up a PC board, go to it. The only high-speed stuff in the circuit is the pulse from the one-shot, and whether or not it's capacitively coupled to something else is of no particular importance.

Although a pull-up resistor is omitted at the output of IC1A (pin 1) for stability, it is required at the output of IC1B (pin 6) if proper operation is desired. Hours of hair-yanking and spasms of voluminous purple prose preceded both of these discoveries.

As the input frequency/rep rate rises, it will be seen that the leading edge of the displayed signal is clipped or truncated. This is due to the inevitable response delays in the sweep circuitry and the horizontal amplifier.

In expensive scopes, a delay line is inserted in the vertical signal circuitry, which, as the frequency increases and the sweep rate in use goes faster, effectively delays the input to the Y-plates until the sweep has time to react to the trigger

Parts List

IC1	LM319 dual comparator
IC2	SN74121 one-shot
IC3	SN7400 quad 2-input NAND
Q1, Q2, Q4, Q5	2N2222 NPN transistors
Q3	2N2907 PNP transistor
R1	100k pot
R2	100k, ¼-Watt resistor
R3, R4, R13, R14, R15	2.2k, ¼-Watt resistor
R5	10k pot
R6	510-Ohm, ¼-Watt resistor
R7, R9, R11	10k, ¼-Watt resistor
R8	390-Ohm, ¼-Watt resistor
R10	1.5k, ¼-Watt resistor
R12	1k, ¼-Watt resistor
R16	5.1k, ¼-Watt resistor
C1	1 uF, 50 V ceramic capacitor
Zeners	See text
D1	Silicon switching diode, e.g., 1N914
R_T	220-Ohm, ¼-Watt plus 2k pot.
C_T	0.001, 0.01, 0.1, 1, 10 uF
S1	SPST switch
S2	DPDT switch
S3	SPDT switch
S4	5-position rotary switch

Input/output jacks, ±15-volt and 5-volt supplies, etc.

pulse. The delay itself is fixed, but it can be seen that it is needed less as the frequency goes down, more as it increases, and it's sufficient to display the trigger point of the input at any frequency.

If you'd like to try it, get a reel of coax, such as RG-58/U, and put a connector on each end. Take the trigger point from the INPUT and the feed to the vertical from the OUTPUT. If you know the length of the coax and the propagation speed, you can calculate the approximate delay.

Operation

The input signal to the sweep may be obtained by teeing from the vertical input of the scope, or by a separate lead tied to whatever trigger signal is required. Begin with the sensitivity at minimum, the level select switch to ground for ac-type signals, or with the input switch to ac for TTL-type signals, for example, that are above true ground. Bring the sensitivity control up slowly until a trace appears, then advance it until a steady trace is seen. If it's a logic signal, for example, switch the input to dc, the level switch to variable, and adjust the level pot to obtain the trace again.

While overloading the input isn't recommended, don't be afraid to crank up the sensitivity until a solid image is obtained. At very low frequency inputs, some instability may be obtained when the input's period is a multiple of the sweep's, but adjusting the sweep rate should cure it.

Other than those points already noted, I haven't any particular precautions to offer, except maybe a reiteration of the warning about the CRT cathode voltage and the capacitor ratings. A thousand volts running amuck amongst ICs and transistors can create a lot of silicon refuse in micro-short order. ■

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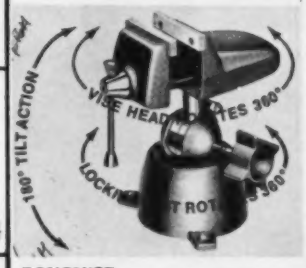
Continuously loaded VHF antenna designed for portable and walkie-talkie applications. Constructed to withstand rough handling, completely insulated with special vinyl coating, it can be bent at all angles without destroying or cracking protective finish. Cannot be accidentally shorted out.

RUBBER DUCKIES

No. 389 – Fits Standard, Motorola, Hy Gain $6.00
No. 374 – BNC Base $9.90
No. 336 – TNC Base Wilson 5 Watts $10.00
No. 338 – "F" Bnc & Wilson 3 Watt & Tempo $10.00
No. 373 – SO 239 Base. Kenwood, Drake $9.00



PANAVISE

It's like no other tool you've ever used. Its head rotates a full 360 degrees — and tilts 180 degrees from vertical to horizontal. Imagine how that kind of versatility simplifies work procedures, just one convenient knob locks work in any desired position.

PANAVISE offers a variety of interchangeable work holding heads, bases and accessories for every imaginable function. But, just because it's small, doesn't mean you can't use PANAVISE for some pretty rugged work. It's a vise every craftsman deserves.

MODEL 300
Original Base
Designed for all normal permanent installations. Three lugs spaced 120 degrees apart provide maximum mounting stability. Overall height: 3-13/16" (97 mm). Base diameter: 5" (127 mm).

MODEL 303
Original Vise Head
Wide 2½" (63 mm) jaws open to 2¼" (57 mm). Head is pressure diecast aluminum alloy, with steel and brass inserts. Hammertone gray/green finish. Replaceable nylon jaws. Package includes both Models 300 & 303 for $21.95.

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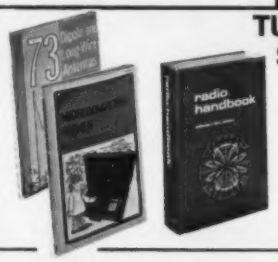

RADIO HANDBOOK (20th Edition)
by William I. Orr, W6SAI. A completely updated 20th edition of the famous communications home handbook that is the electronics industry standard for engineers, technicians, and advanced amateurs. Explains in authoritative detail how to design and build all types of radio communications equipment. Contains greatly enlarged section on semiconductors and IC circuit design. Includes sets design and equipment, rfq circuits, linear amplifiers, both solid state and tube types, vhf and uhf transmitters and converters, as well as special purposes and logic circuitry, plus completely revised chapter on electronics mathematics. 1080 pages, 6¾ x 9¾, hardbound.
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by Walter G. Jung. The first book of its kind to be published. Covers not only the basic theory of the IC op amp in great detail, but also includes over 250 practical circuit applications. Warmly illustrated. Organized into three basic parts: introduction to the IC op amp and general considerations, practical circuit applications, and appendixes of manufacturers' reference material. 550 pages, 5½ x 8½, softbound.
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by Walter Jung. Provides an excellent introduction to the field of IC timers by presenting a collection of various circuit "recipes" useful in applying the devices. Arranged in three parts, the first part gives basic and generalized information. Part II, the applications section, is the "meat" of the book and includes over 100 different circuits for a wide range of uses. Part III contains reproductions of manufacturers data sheets, second-source manufacturers, and more. This book is a valuable reference for the hobbyist, the technical or engineering student, or professional. 288 pages, 5½ x 8½, softbound.
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CMOS COOKBOOK
by Don Lancaster. Tells all you need to know to understand and profitably use this inexpensive and genuinely fun to work with digital logic family. First an explanation of what CMOS is, how it works, and how to power it, plus usage rules, state testing, breadboarding, interface, and other basics is given. Then a mind-eating of over 100 devices, including gates and one dimensional counters is given. Subjects covered include gate fundamentals, tri-state logic, redundant logic design techniques, multivibrators, non-volatile memory techniques, clocked JK and D flip-flops, counter and register techniques, op amps, analog switches, phase-locked loops and much more. A must for the student, hobbyist, teacher, technician, or engineer who wants to learn about CMOS. Filled with practical applications. 416 pages, 5½ x 8½, softbound.
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- Phase lock-loop (PLL) oscillator circuit minimizes unwanted spurious responses.
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- Built-in AC and 12 VDC power supplies.
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TEMPO ONE — HF Transceiver 80-10M USB, CW & AM — $399.00

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TEMPO SSB/ONE
SSB adapter for the Tempo VHF/One
* Selectable upper or lower sideband * Plugs directly into the VHF/One with no modification * Noise blanker built-in. * RIT and VXO for full frequency coverage * $225.00

ATLAS 350-XL

● ALL SOLID STATE ● 350 WATTS P.E.P. OR CW INPUT
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Illustrated with optional AC supply, Auxiliary VFO, and Digital Dial.

The all new Atlas 350-XL has all the exciting new features you want, plus superior performance and selectivity control never before possible Price: $1195.00
● 10-160 Meters
Full coverage of all six amateur bands in 500 kHz segments. Primary frequency control provides highly stable operation. Also included is provision for adding up to 10 additional 500 kHz segments between 2 to 22 MHz by plugging in auxiliary crystals.
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P.E.P. and CW input. Enough power to work the world barefoot!

IDEAL FOR DESKTOP OR MOBILE OPERATION
Measuring just 5 in. high x 12 in. wide x 12⅛ in. deep, and weighing only 13 pounds, the Atlas 350-XL offers more features, performance and value than any other transceiver, regardless of size, on the market today!
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● 305 plug-in auxiliary VFO — $155.00
● 311 plug-in crystal oscillator — $135.00
● DMK-XL plug-in mobile mounting kit — $65.00

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Ideal for Receivers — Converters
High Gain — Low Noise

FEATURES:
- Small size
- Increases sensitivity of most receivers
- Gold-plated copper shielding
- Single or double stage models
- Diode protected, dual-gated FETs

SPECIFICATIONS:
Power: 6 VDC to 18 VDC (12 VDC recommended)
Size: a. Single stage: 1" x 1⅜" x ⅝"
b. Double stage: 2" x 1⅜" x ⅝"
MOSFET: FT 0601, 500 MHz, dual-gate diode protected MOSFET

When ordering be sure to specify:
1. frequency of operation
2. single or double band stage
3. kit or assembled version

FREQ. (MHz)	USE	STAGES	DELUXE PREAMPLIFIER GAIN dB	NF dB	WIRED
50 to 54	6 METER	SINGLE	25	2	$15.50
		DOUBLE	48	2	$28.50
108 to 144	VHF AIRCRAFT	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
135 to 139	SATELLITE	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
144 to 148	2 METER	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
146 to 174	HIGH BAND	SINGLE	20	2.5	$14.50
		DOUBLE	40	2.5	$26.50
220 to 225	1¼ METER	SINGLE	18	2.5	$14.50
		DOUBLE	35	2.5	$26.50
225 to 300	UHF AIRCRAFT	SINGLE	15	2.5	$14.50
		DOUBLE	30	2.5	$26.50

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ADD-ON POWER!

Highest quality, American-made "brand" transistors are fully protected for VSWR, short and overload, reverse polarity. Highly effective heat sinking assures long life, reliable performance. Black anodized containers...exclusive KLM extrusions, **have seven, full length fins on both sides!**

KLM RF Power Amplifiers

- A simple, add-on-immediately RF amplifier.
- Merely coax-connect amplifier between antenna and transceiver.
- No tuning! Efficient strip-line broad band design.
- Automatic! Internal RF-sensor-controlled relay connects amplifier whenever transmitter is switched on. Manual, remote-position switching is optional.
- Models for 6,2,1¼ meters, 70CM amateur bands plus MARS coverage.
- Two types: **Class C** for FM/CW. **Linear** for SSB/AM/FM/CW.
- Negligible insertion loss on receive.
- American made by KLM.

New Model	List Price		
PA 2-25B	$ 69.95	PA 4-70BC	189.95
PA 4-70BL	189.95	PA 15-60BC	164.95
PA 15-40BL	109.95	PA 45-120BC	209.95
PA 15-80BL	179.95	PA 4-40C	169.95
PA 15-160BL	259.95	PA 15-35CL	154.95
PA 45-140BL	219.95	PA 15-110CL	279.95

TEMPO VHF/ONE PLUS

The Tempo/ONE PLUS offers full 25 watt output or a selectable 3 to 15 watt low power output, remote tuning on the microphone, sideband operation with the SSB/ONE adapter, MARS operation capability, 5 kHz numerical LED, and all at a lower price than its time tested predecessor . . . the Tempo VHF ONE.

The Tempo VHF/One Plus is a VHF/FM transceiver for dependable communication on the 2 meter amateur band ● Full 2 meter coverage, 144 to 148 MHz for both transmit and receive ● Full phase lock synthesized (PLL) ● Automatic repeater split — selectable up or down ● Two built-in programmable channels ● All solid state ● 800 selectable receive frequencies with simplex and +600 kHz transmit frequencies for each receive channel. Price: $399.00

THE BIG SIGNAL

UNADILLA "W2AU" BALUN

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World Famous Among Hams, Armed Forces, Communications Industry. Why?
- Each BALUN 2KW PEP tested
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- 600Ω Putt — No Insulator Needed
- Only 7 oz. and 6" x 1¼"
- Supreme!
- Reduces TVI
- Improves F/B ratios
- Weatherproof
- Complete Instructions
- Antenna Length Table

THE OLD RELIABLE™

REYCO "W2VS" ANTENNA COILS

$21.95 pair

*FREQUENCY-MATCHED PAIRS!

Turns Your Antenna into A Multi-Band* Professional's Dream! Reyco* Why?
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- Only 5 oz. and 5"x 1¼" diameter
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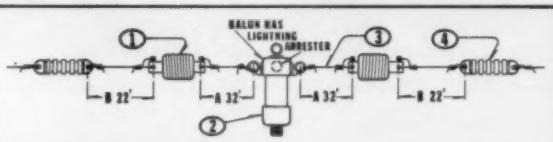
- Models for 10, 15, 20, 40 Meters
- Complete Instructions
- Multi-Band Length/Tuning Data



W2AU/W2VS ● 5 BAND 10/80 METER ANTENNA KIT by UNADILLA/REYCO

GIVES YOU OPERATION ON 10 ● 15 ● 20 ● 40 ● 80 METERS

(DESIGNED CLOSELY TO 5 BAND TRAP DIPOLE PARAMETERS PER A.R.R.L. HANDBOOK, HF ANTENNA CHAPTER 21 'A MULTIBAND TRAP ANTENNA')

Every Component of This Kit is a Highly Crafted, old Line UNADILLA/REYCO Product Time Tested by HAMS, COMMERCIAL & ARMED FORCES FACILITIES — AROUND THE WORLD — FOR OVER 10 YEARS!

COMPLETE KIT (Nothing else needed)
- 2 ea. W2VS REYCO KW-40 TRAPS
- 1 ea. W2AU 'BIG SIGNAL' BALUN 1:1
- 120 Ft. RUGGED #14-7 Strand Copper Wire
- 2 ea. W2AU SHATTERPROOF END-sulators
- INSTRUCTIONS
- $48.25

MICROWAVE FILTER COMPANY, INC.

14-16 Pin Dip IC Inserter | INS-1416 | $3.49

DIP/IC EXTRACTOR TOOL

The EX-1 Extractor is ideally suited for hobbyist or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.

Extractor Tool | EX-1 | $1.49

P.C. BOARD

The 6 x 4.5 x 1/16 inch board is made of glass reated EPOXY Laminate and features solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector, with contacts on standard .156 spacing. Edge contacts are non-dedicated for maximum flexibility.

The board contains a matrix of .040 in. diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Typical density is 18 of 14-Pin or 16-Pin DIP's. Components may be soldered directly to the board or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual busses running the full length of the board for complete wiring flexibility. These busses enable access from edge contacts to discrete components. These busses can also serve to augment the voltage or ground busses, and may be cut to length for particular applications.

Hobby Board | H-PCB-1 | $4.99

PC CARD GUIDES

TR-1 consists of 2 guides precision molded with unique spring finger action that dampens shock and vibration, yet permits smooth insertion or extraction. Guides accommodate any card thickness from .040 .100 inches.

QUANTITY – ONE PAIR (2 pcs.)

Card Guides | TR-1 | $1.89

PC CARD GUIDES & BRACKETS

TRS-2 kit includes 2 TR-1 guides plus 2 mounting brackets. Support brackets feature unique stabilizing post that permits secure mounting with only 1 screw

Guides & Brackets | TRS-2 | $3.79

QUANTITY – ONE SET (4 pcs.) QUANTITY – ONE SET (4 pcs.)

PC EDGE CONNECTOR

44 Pin, dual read out, .156" (3,96 mm) Contact Spacing, .025" (0,63 mm) square wire-wrapping pins.

P.C. Edge Connector | CON-1 | $3.49

P.C.B. TERMINAL STRIPS

The TS strips provide positive screw actioned clamping action. Accommodate wire sizes 14-30 AWG (1, 0.5, 25mm). Pins are solder plated copper. .062 inch (1mm) diameter, on .200 inch (5mm) centers.

4-Pole	TS- 4	$1.39
6-Pole	TS- 6	$1.89
12-Pole	TS-12	$2.59

WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1

Wire-Wrapping Kit | WK-4B (Blue) | $25.99

HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30	$6.95
Modified Wrap	WSU-30M	$7.95

WIRE-WRAPPING TOOL

For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630	$34.95*
For AWG 26-28	BW-2628	$36.95*

Bit for AWG 30	BT-30	$3.95
Bit for AWG 26-28	BT-2628	$7.95

*USE "C" SIZE NI-CAD BATTERIES (NOT INCLUDED)

ROLLS OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30 AWG Blue Wire 50ft Roll	R-30B-0050	$1.98
30 AWG Yellow Wire 50ft Roll	R-30Y-0050	$1.98
30 AWG White Wire 50ft Roll	R-30W-0050	$1.98
30 AWG Red Wire 50ft Roll	R-30R-0050	$1.98

WIRE DISPENSER

- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable (For refills, see above)

Blue Wire	WD-30-B	$3.95
Yellow Wire	WD-30-Y	$3.95
White Wire	WD-30-W	$3.95
Red Wire	WD-30-R	$3.95

PRE CUT PRE STRIPPED WIRE

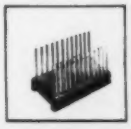
Wire for wire wrapping AWG-30 (0.25mm) KYNAR® wire, 50 wires per package stripped 1" both ends.

30 AWG Blue Wire 1" Long	30-B-50-010	$.95
30 AWG Yellow Wire 1" Long	30-Y-50-010	$.95
30 AWG White Wire 1" Long	30-W-50-010	$.95
30 AWG Red Wire 1" Long	30-R-50-010	$.95
30 AWG Blue Wire 2" Long	30-B-50-020	$.95
30 AWG Yellow Wire 2" Long	30-Y-50-020	$.95
30 AWG White Wire 2" Long	30-W-50-020	$.95
30 AWG Red Wire 2" Long	30-R-50-020	$.95
30 AWG Blue Wire 3" Long	30-B-50-030	$.95
30 AWG Yellow Wire 3" Long	30-Y-50-030	$.95
30 AWG White Wire 3" Long	30-W-50-030	$.95
30 AWG Red Wire 3" Long	30-R-50-030	$.95
30 AWG Blue Wire 4" Long	30-B-50-040	$.95
30 AWG Yellow Wire 4" Long	30-Y-50-040	$.95
30 AWG White Wire 4" Long	30-W-50-040	$.95
30 AWG Red Wire 4" Long	30-R-50-040	$.95
30 AWG Blue Wire 5" Long	30-B-50-050	$.95
30 AWG Yellow Wire 5" Long	30-Y-50-050	$.95
30 AWG White Wire 5" Long	30-W-50-050	$.95
30 AWG Red Wire 5" Long	30-R-50-050	$.95
30 AWG Blue Wire 6" Long	30-B-50-060	$.95
30 AWG Yellow Wire 6" Long	30-Y-50-060	$.95
30 AWG White Wire 6" Long	30-W-50-060	$.95
30 AWG Red Wire 6" Long	30-R-50-060	$.95

WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30, Roll of wire R-30B-0050, (2) 14 DIP's, (2) 16 DIP's and Hobby Board H-PCB-1.

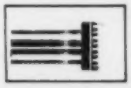
Wire-Wrapping Kit | WK-3B (Blue) | $16.95



DIP SOCKET

Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, gold plated pins .025 (0,63mm) sq., .100 (2,54mm) center spacing.

14 Pin Dip Socket	14 Dip	$0.79
16 Pin Dip Socket	16 Dip	$0.89



RIBBON CABLE ASSEMBLY SINGLE ENDED

With 14 Pin Dip Plug 24" Long (609mm)	RE14-24	$3.35
With 16 Pin Dip Plug 24" Long (609mm)	RE16-24	$3.75

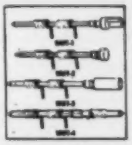
DIP PLUG WITH COVER FOR USE WITH RIBBON CABLE

14 Pin Plug & Cover	14-PLG	$1.49
16 Pin Plug & Cover	16-PLG	$1.59

QUANTITY: 2 PLUGS, 2 COVERS

RIBBON CABLE ASSEMBLY DOUBLE ENDED

With 14 Pin Dip Plug - 2" Long	DE 14-2	$3.79
With 14 Pin Dip Plug - 4" Long	DE 14-4	$3.89
With 14 Pin Dip Plug - 8" Long	DE 14-8	$3.99
With 16 Pin Dip Plug - 2" Long	DE 16-2	$4.15
With 16 Pin Dip Plug - 4" Long	DE 16-4	$4.25
With 16 Pin Dip Plug - 8" Long	DE 16-8	$4.39

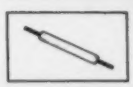


TERMINALS

- .025 (0,63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated

Slotted Terminal	WWT-1	$2.98
Single Sided Terminal	WWT-2	$2.98
IC Socket Terminal	WWT-3	$3.98
Double Sided Terminal	WWT-4	$1.98

25 PER PACKAGE



TERMINAL INSERTING TOOL

For inserting WWT-1, WWT-2, WWT-3, and WWT-4 Terminals into .040 (1,01mm) Dia. Holes.

INS-1 | $2.49

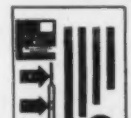
WIRE CUT AND STRIP TOOL

Easy to operate ... place wire (up to 4) in stripping slot with cable clamping beyond cutter blades ... press tool and pull ... wire is cut and stripped to proper "wire-stripping" length. The hardened steel cutting blades and sturdy construction of the tool insure long life.

Strip length easily adjustable for your applications.

DESCRIPTION	MODEL NUMBER	ADJUSTABLE "BARREL" LENGTH OF STRIPPED WIRE (SHOWN)	TO (SHOWN)	Price
24 ga. Wire Cut and Strip Tool	ST-100-24	1⅞"	1⅞"	$ 8.75
26 ga. Wire Cut and Strip Tool	ST-100-26	1⅞"	1⅞"	$ 8.75
28 ga. Wire Cut and Strip Tool	ST-100-30-STS	⅛"	1⅛"	$ 8.75
28 ga. Wire Cut and Strip Tool	ST-100-28	⅛"	1⅛"	$11.95
30 ga. Wire Cut and Strip Tool	ST-100-30	⅛"	1⅛"	$11.95

Not shown: List of our new short TOOLS for shops of tough measures



WIRE-WRAPPING KITS

Contains: Hobby Wrap Tool WSU-30, (50 ft.) Roll of wire Prestripped wire 1" to 4" lengths (50 wires per package) stripped 1" both ends.

Wire Wrapping Kit (Blue)	WK 2-B	$12.95
Wire Wrapping Kit (Yellow)	WK 2-Y	$12.95
Wire Wrapping Kit (White)	WK 2-W	$12.95
Wire Wrapping Kit (Red)	WK 2-R	$12.95

HI-Q BALUN

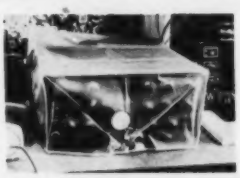
- For dipoles, yagis, inverted vees, doublets & quads
- For full legal power & more
- Puts power in antenna
- Broadbanded 3-40Mhz.
- Small, light, weather-proof
- 1:1 impedance ratio
- Replaces center insulator
- Helps eliminate TVI
- Fully Guaranteed

$9.95 PPD U.S.A.

Van Gorden Engineering

DUST COVERS

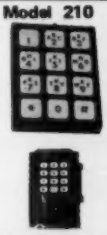
•Our covers are custom designed to protect all popular equipment models. •They are made of rugged high quality vinyl and are machine stitched for extra strength. •They add that professional look to your station. $3.95.



COVER CRAFT

Model 210

Model 200 V



Model HT 220

Model 220

CES Touch Tone Pads

- Model 300 – acoustic coupling, $49.95
- Model 210 – for mounting on walkies or hand-helds, $39.95
- Model 220 – CES can now offer you a TOUCH TONE back for Standard Communications hand-held radios. This is the complete back assembly with the TOUCH TONE encoder mounted and ready to plug into the private channel connector. Also included is a LED tone generator indicator and an external tone deviation adjustment. $60.95.
- Model 215 (miniature version of 210) – $39.95
- Model 221 long – $99.95
- Model 221 short – $89.95

TUFTS RADIO CATALOG — TUFTS RADIO

Tufts Radio Electronics ● (617) 395-8280
TC-9

ATB-34

cushcraft

4 ELEMENT BEAM | **10-15-20 METERS**

Cushcraft engineers have incorporated more than 30 years of design experience into the best 3 band HF beam available today. **ATB-34** has superb performance with three active elements on each band, the convenience of easy assembly and modest dimensions. Value through heavy duty all aluminum construction and a price complete with 1-1 balun.

SPECIFICATIONS

FORWARD GAIN -	EXCELLENT	LONGEST ELEMENT -	32'8"
F/B RATIO -	30 dB	TURNING RADIUS -	18'9"
VSWR -	1.5-1	WIND SFC -	5.4 Sq.Ft.
POWER HANDLING -	2000 WATTS PEP	WEIGHT -	42 Lbs.
BOOM LENGTH/DIA. -	18' x 2 1/8"	WIND SURVIVAL -	90 MPH

UPS SHIPPABLE **$239.95 COMPLETE**

ENJOY A NEW WORLD OF DX COMMUNICATIONS WITH ATB-34

VHF - UHF DX-ARRAYS
144, 220, 430 mhz

20 ELEMENT DX - ARRAYS
20 ELEMENT SPECIFICATIONS

Forward Gain ------- 14.2 db
F/B Ratio ---------- 30 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 46°
vertical ---------- 29°
Impedance ---------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	119"	78"	42"
Width x Depth	75" x 30"	53" x 20"	29" x 11"
Turning Radius	48"	32"	18"
Maximum Mast Dia.	1 1/2"	1 1/2"	1 1/2"
Net Weight Lbs.	8	7	6

Vertical support mast not supplied

2 METER DX-120	1 1/4 METER DX-220	3/4 METER DX-430
Am. Net	$42.95	$37.95	$32.95

40 ELEMENT DX - ARRAYS
40 ELEMENT SPECIFICATIONS

Forward Gain --------- 17 db
F/B Ratio ---------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 32°
vertical ---------- 26°
Impedance ---------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

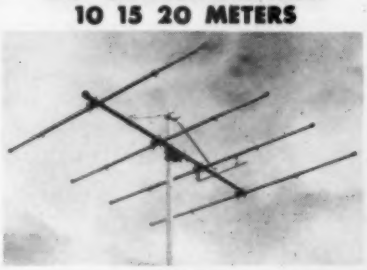
	144 Mhz	220 Mhz	432 Mhz
Height	118"	78"	42"
Width x Depth	192" x 30"	132" x 30"	73" x 11"
Turning Radius	101"	65"	36"
Maximum Mast Dia.	2 1/2"	2 1/2"	2 1/2"
Net Weight Lbs.	32	22	13
Wind Rating	90 mph	90 mph	90 mph
Stack Kit No.	DXK-140	DXK-240	DXK-440
Amateur Net	$59.95	$54.95	$39.95

80 ELEMENT DX - ARRAYS
80 ELEMENT SPECIFICATIONS

Forward Gain --------- 20 db
F/B Ratio ---------- 20 db
Fwd. Lobe at 1/2 Pwr. Point
horizontal ---------- 22°
vertical ---------- 13°
Impedance ---------- 52 ohms
VSWR at Frequency ---- 1 - 1
Bandwidth W/VSWR
Less than 2 - 1 ---- 4 mhz
Power Handling -- 2 KW PEP

	144 Mhz	220 Mhz	432 Mhz
Height	275"	162"	97"
Width x Depth	192" x 30"	132" x 30"	73" x 11"
Turning Radius	101"	65"	36"
Maximum Mast Dia.	2 1/2"	2 1/2"	2 1/2"
Wind Rating	90 mph	90 mph	90 mph
Net Weight Lbs.	64	43	24
Stack Kit No.	DXK-180	DXK-280	DXK-480
Amateur Net	$109.95	$89.95	$79.95

HF MONOBEAMS
10 15 20 METERS



10 METERS

3 ELEMENT BEAM: You can have an outstanding signal using this compact three element beam. It is easily mounted on a lightweight rotator and takes only a limited amount of space.
MODEL NO. A28-3 $60.95

4 ELEMENT BEAM: A real DX'ers beam for the active ham who wants a top signal on 10 meters. Mount on a good ham rotator. MODEL NO. A28-4 $79.95

SPECIFICATIONS	A28-3	A28-4
BOOM	1 1/2" x 10'	1 5/8" x 18'
LONGEST ELEMENT	17' 6"	18'
ELEMENT DIAMETER	7/8" - 1/2"	7/8" - 3/4"
TURNING RADIUS	10'	14' 3"
FORWARD GAIN	8 db	10 db
FRONT TO BACK	22 db	25 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	11 lbs.	21 lbs.

15 METERS

3 ELEMENT BEAM: A high quality beam which can be mounted on a mast with other antennas. A heavy duty TV rotator will handle it.
MODEL NO. A21-3 $89.95

4 ELEMENT BEAM: For the 15 meter enthusiast this beam will give real DX performance. When mounted on a good ham rotator it will withstand the most adverse weather conditions.
MODEL NO. A21-4 $119.95

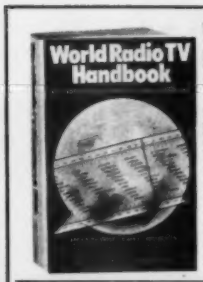
SPECIFICATIONS	A21-3	A21-4
BOOM	1 5/8" x 12'	1 3/4" x 21' 6"
LONGEST ELEMENT	22' 10"	22' 10"
ELEMENT DIAMETER	7/8" - 3/4"	7/8" - 3/4"
TURNING RADIUS	13' - 3"	15' - 9"
FORWARD GAIN	8 db	10 db
FRONT TO BACK	22 db	25 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	16 lbs.	32 lbs.

20 METERS

2 ELEMENT BEAM: Full size beam performance for the active 20 meter ham with limited space and budget.
MODEL NO. A14-2 $109.95

3 ELEMENT BEAM: A real DX-er's beam with full .15 wavelength element spacing. The heavy duty construction gives years of trouble free service. MODEL NO. A14-3 $139.95

SPECIFICATIONS	A14-2	A14-3
BOOM	1 5/8" x 10'	1 5/8" x 20' 6"
LONGEST ELEMENT	35' 10"	35' 10"
ELEMENT DIAMETER	1 1/8" - 3/4"	1 1/8" - 3/4"
TURNING RADIUS	18'	21'
FORWARD GAIN	5 db	9 db
F/B RATIO	13 db	22 db
SWR @ FREQUENCY	1 to 1	1 to 1
WEIGHT	30 lbs.	35 lbs.



World Radio TV Handbook 1978

A Complete Directory of International Radio and Television

The most exhaustive and authoritative guide to broadcasting and television stations around the world today. **WORLD RADIO TV HANDBOOK 1978** is an indispensable manual for anyone with a working interest in radio and television. It features:

- Names and addresses of broadcast companies and stations by country
- Names and titles of leading officials and personnel
- Listing by frequency of shortwave stations around the world
- Program data including frequencies, wave lengths, transmitter power, call signs, times, antenna arrays (in each language)

Plus, a special, in-depth editorial section with professional articles, suggestions and tips—and much, much more. **WORLD RADIO TV HANDBOOK 1978** is available now for only $11.95.

HF Verticals 10-80 Meters

● efficient top ring ● fiberglass trap forms ● enameled wire coils ● solid aluminum capacitors ● no tuning required ● full compression clamps ● omnidirectional coverage ● reinforced base ● mast or ground mounting ● pre-marked sections ● easy assembly ● superior quality

3 BAND 20-15 meters/Model ATV-3 ..... $49.95
4 BAND 40-20-15-10 meters/ Model ATV-4 ..... $89.95
5 BAND 80-40-20-15-10 meters /Model ATV-5 ..... $109.95

cushcraft

Speak up.

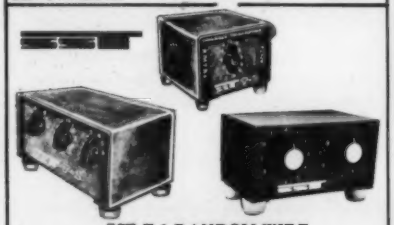
We know all about up. In fact, we're number one from the ground up...when it comes to amateur communications towers. We've been building them for HAMS for more than two decades.

Whether you're thinking crank-up, guyed or free-standing, check with us first. We're Tri-Ex. Reliable, dependable.

When we say number one from the ground up, we're talking about towers like Tri-Ex's new "Big W" shown here. It's a free-standing crank-up with a height of 80-ft, providing good DX capability at low cost. Ideal for serious HAMS.

Model W51
(51' Self-supporting)
$850.00

Tri-Ex TOWER CORPORATION



SST T-1 RANDOM WIRE ANTENNA TUNER

All band operation (160-10 meters) with any random length of wire. 200 watt output power capability — will work with virtually any transceiver. Ideal for portable or home operation. Great for apartments and hotel rooms — simply run a wire inside, out a window, or anyplace available. Toroid inductor for small size: 4-1/4" x 2-3/8" x 3". Built-in neon tune-up indicator. SO-239 connector. Attractive bronze finished enclosure. Only $29.95

SST T-2 ULTRA TUNER

Tunes out SWR on any coax fed antenna as well as random wires. Works great on all bands (160-10 meters) with any transceiver running up to 200 watts power output. Increases usable bandwidth of any antenna. Tunes out SWR on mobile whips from inside your car.
Uses toroid inductor and specially made capacitors for small size: 5¼" x 2¼" x 2½". Rugged, yet compact. Attractive bronze finished enclosure. SO-239 coax connectors are used for transmitter input and coax fed antennas. Convenient binding posts are provided for random wire and ground connections. Only $49.95

SST T-3 IMPEDANCE TRANSFORMER

Matches 52 ohm coax to the lower impedance of a mobile whip or vertical. 12 position switch with taps spread between 3 and 52 ohms. Broadband from 1-30 MHz. Will work with virtually any transceiver — 300 watt output power capability. SO-239 connectors. Toroid inductor for small size: 2-3/4" x 2" x 2-1/4." Attractive bronze finish. Only $19.95

6 METER BEAMS

3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Length	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

COAXIAL DUAL STACKING KITS

Double your effective radiated power by stacking 6 meter beams. Cush Craft coaxial stacking kits provide a simple and efficient method for realizing 3 db additional gain while maintaining the superior characteristics of our single beams. The stacking kits are complete with RG-59/U cable and preassembled fittings for direct 52 ohm feed.

MODEL NO.	FOR STACKING	AMATEUR NET
A535-SK	A50-3 or A50-5	$15.95
A561-SK	A50-6 or A50-10	$17.95

new
RINGO RANGER for FM

4.5 dB* – 6 dB Omnidirectional GAIN BASE STATION ANTENNAS FOR MAXIMUM PERFORMANCE AND VALUE**

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz take 1 ½" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdlg. Watts	100	500	100	100	200
Wind area sq. ft.	.21'	.21'	.07'	.20'	.10'

9-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 22' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 160 MHz, 1000 watts, wind area 2.88 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.86 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

8-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F-B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK.	complete 4 element stacking kit
A14-SK.	4 element coax harness only
A147-VPK.	complete 11 element stacking kit
A147-SK.	11 element coax harness only
A449-SK.	6 + 11 element coax harness only

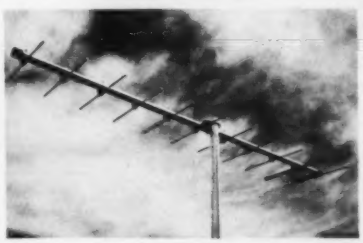
6-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/48"	44"/40"	60"/13"	35"/30"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	12.2/25	9/20	13.2/23	11/25	13.2/28
½ Power beam	48°	68°	48°	60°	48°
Wind area sq. ft.	1.21	.45	.39	.30	.80
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.43 sq. ft.

HIGH PERFORMANCE VHF YAGIS



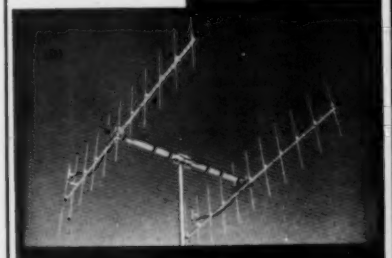
3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O. D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O. D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	66"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	26 dB	26 dB	26 dB
Fwd. Lobe @ ½ pwr. pt.	48	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1



AMATEUR FM ANTENNAS		DX-VPB	9.95
A147-4	$ 19.95	DX-ARRAY-40 ELEMENT	
A147-11	29.95	DXK-140	$ 59.95
A147-20T	54.95	DXK-240	54.95
A147-22	84.95	DXK-440	39.95
A220-7	21.95	DX-ARRAY-80 ELEMENTS	
A220-11	27.95	DXK-180	$109.95
A220-22	74.95	DXK-280	89.95
A449-6	21.95	DXK-480	79.95
A449-11	27.95	HF MONOBEAMS	
AFM-4D	59.95	A14-2	$109.95
AFM-24D	57.95	A14-3	139.95
AFM-44D	54.95	A21-3	89.95
AR-2	21.95	A21-4	119.95
AR-6	32.95	A28-3	69.95
AR-25	29.95	A28-4	79.95
AR-220	21.95	PROLINE VHF BEAMS	
AR-450	21.95	APL-2SK	$ 21.95
ARX-2	32.95	APL-6SK	24.95
ARX-2K	13.95	APL-6S	129.95
ARX-220	32.95	APL-210	99.95
ARX-450	32.95	TRI BAND BEAM	
AMATEUR FM STACKING		AFB-1	$ 14.95
A14-SK	$ 15.95	ATB-34	239.95
A14-VPK	23.95	TWIST ANTENNAS	
A21-SK	15.95	A14T-MB	$ 15.95
A220-VPK	23.95	A144-10T	34.95
A147-SK	15.95	A144-20T	54.95
A147-VPK	29.95	A144-80QT	349.95
A449-SK	15.95	A432-20T	49.95
A449-VPK	23.95	VHF/UHF BEAMS	
BIG WHEEL ANTENNAS		A50-3	$ 32.95
A8W-125	$ 12.95	A50-5	49.95
A8W-145	24.95	A50-6	69.95
A8W-144	27.95	A50-10	99.95
BLITZ BUG		A144-7	21.95
LAC-1	$ 4.50	A144-11	32.95
LAC-2	4.50	A430-11	24.95
DX-ARRAYS-20 ELEMENT		VHF/UHF STACKING KITS	
DX-120	$ 42.95	A11-SK	$ 15.95
DX-220	37.95	A17-SK	15.95
DX-420	32.95	A41-SK	15.95
DX-ARRAY BALUNS		A535-SK	15.95
DX-1BN	$ 12.95	A561-SK	17.95
DX-2BN	12.95	AQK-144	89.95
DX-4BN	12.95	AQK-444	69.95

TUFTS RADIO CATALOG TUFTS RADI

For all you hams with little cars ...

We've got the perfect mobile rig for you.

The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

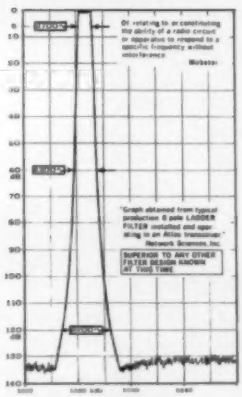
250 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.


Graph obtained from typical production 8 pole LADDER FILTER installed and operating in an Atlas transceiver
Network Sciences, Inc.
SUPERIOR TO ANY OTHER FILTER DESIGN KNOWN AT THIS TIME

PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.

A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

Atlas 210X or 215X	$765.00
w/noise blanker	$810.00
Accessories:	
AC Console 110/220 V	$155.00
Portable AC supply 110/220 V	$105.00
Plug-in mobile kit	$55.00
10X Osc. less crystals	$55.00
Digital Dial DD-8B	$235.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

HUSTLER®

"the home of originals"

AMATEUR ANTENNAS

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL BBLT-146
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $33.75

MODEL BBL-146
47" antenna mounts on any flat surface, roof, deck or fender in ¾" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $31.80

HUSTLER "BUCK-BUSTER"

MODEL BF-2
50" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ¾"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included).
Price: $9.00

DELUXE MOBILE MOUNTS

For medium length, light weight antennas with ¾" — 24 base.

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached.
Price: $14.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. Price: $17.20

MODEL GCM-1
Rain gutter mount fits all shapes, angles even listed trim line gutters. Includes 15½" swivel ball. Price: $8.00

MODEL MM-1
Cowl mount installs in 1" hole. Includes 3/8" swivel ball and SO-239 connectors.
Price: $7.80

MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. Price: $8.00

MODEL C-TB
Ball mount complete with mounting hardware.
Price: $6.30

SUPER GAIN MOBILES

Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS— TRUNK LIP MOUNT
MODEL HPT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 48". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259.
Price: $22.65

VHF/UHF ANTENNA— ROOF MOUNT
MODEL UHT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ¾" hole. Includes 15' RG-58-U.
Price: $9.95

MODEL CGT-144
Get big signal performance, superior receiving capability with this 8½" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259.
Price: $41.30

MODEL CG-144
Same characteristics as CGT-144 supplied with ¾"-24 base to fit all mobile ball mounts—Length is 85". Mount and cable not included.
Price: $25.50

VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL THF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259.
Price: $16.65

RESONATOR SPRING— STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation.
Price: $ 5.95

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SSM-2
Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes coiled wire, steel back-up plate and mounting hardware.
Price: $19.20

QUICK DISCONNECT— 100% STAINLESS STEEL
MODEL QD-1
Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ¾"-24 threads—female one end, male the other.
Price: $16.95

FEED LINE MODEL L-14-240
Get known performance, maximum signal strength at the minimum noise pickup in this MIL SPEC 20 length of RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver.
Price: $6.95

MODEL GS-144A — Deluxe, Two Meter Colinear for Repeater or any fixed station operation. 6 db gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator ½ wave lower section, ½ wave phasing, ½ wave upper section. Height 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 2½" O.D. SO-239 coax connector
Price: $47.85

STANDARD HUSTLER RESONATORS

Power Rating: 400 Watts SSB

Model	Band	Price
RM-10	10 meters	$ 6.50
RM-15	15 meters	6.95
RM-20	20 meters	7.30
RM-40	40 meters	13.20
RM-75	75 meters	15.50
RM-80	80 meters	15.95

SUPER HUSTLER RESONATORS

Power Rating: Legal Limit SSB
Supers have widest bandwidth

Model	Band	Price
RM-10S	10 meters	$11.30
RM-15S	15 meters	12.65
RM-20S	20 meters	13.00
RM-40S	40 meters	15.50
RM-75S	75 meters	30.00
RM-80S	80 meters	30.40

For 6-10-15-20-40-75-80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ¾"-24 threads to fit mobile ball mount or bumper mount.

HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

MODEL MO-2
For bumper mounting—Fold is at roof line 27" above base. Price: $22.00

MODEL MO-1
For deck or fender mounting—Fold is at roof line 15" above base. Price: $22.00

Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-STV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.5 to 1 or better at band edges.
- Hustler exclusive trap covers "Spirit" extruded to otherwise unobtainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass tray forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss — high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ¾"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—Full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5"
MODEL 4-STV
Weight: 15 lbs.
Price: $89.95

This NEW MFJ Versa Tuner II . . .

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built-in balun. Up to 300 watts RF output. Matches everything from 160 thru 10 meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. $79.95.

Antenna matching capacitor. 208 pf. 1000 volt spacing.

Sets power range, 300 and 30 watts. Pull for SWR.

Meter reads SWR and RF watts in 2 ranges.

Efficient airwound inductor gives more watts out and less losses.

Transmitter matching capacitor. 208 pf. 1000 volt spacing.

Only MFJ gives you this MFJ-941 Versa Tuner II with all these features at this price:

A SWR and dual range wattmeter (300 and 30 watts full scale) lets you measure RF power output for simplified tuning.

An antenna switch lets you select 2 coax fed antennas, random wire or balance line, and tuner bypass.

A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

A 1:4 balun for balance lines. 1000 volt capacitor spacing. Mounting brackets for mobile installations (not shown).

With the NEW MFJ Versa Tuner II you can run your full transceiver power output — up to 300 watts RF power output — and match your transmitter to **any** feedline from 160 thru 10 Meters whether you have coax cable, balance line, or random wire.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

It travels well, too. Its ultra compact size 5x2x6 inches fits easily in a small corner of your suitcase.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas. Quality five way binding posts are used for the balance line inputs (*), random wire input (1), and ground (⏚).

ANTENNA SWITCH lets you select 2 coax fed antennas, random wire or balance line, and tuner bypass.

$59.95

BRAND NEW

MFJ-941 VERSA TUNER II

New efficient air wound coil for more watts out.

Only MFJ uses an efficient air wound inductor (12 positions) in this class of tuners to give you more watts out and less losses than a tapped toroid. Matches everything from 160 thru 10 Meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. Up to 300 watts RF output. 1:4 balun for balance lines. Tune out the SWR of your mobile whip **from inside your car.** Works with all rigs. Ultra compact 5x2x6 inches. SO-239 connectors. 5 way binding posts. Ten Tec enclosure.

$49.95

BRAND NEW

MFJ-900 ECHO TUNER

Same as MFJ-941 Versa Tuner, but does not have built-in balun for balance lines. Tunes coax lines and random lines.

$39.95

MFJ-16010 RANDOM WIRE TUNER

Operate 160 thru 10 Meters. Up to 200 watts RF output. Matches high and low impedances. 12 position inductor. SO-239 connectors. 2x3x4 inches. Matches 25 to 200 ohms at 1.8 MHz.

$49.95

BRAND NEW

MFJ-202 RF NOISE BRIDGE

This MFJ RF Noise Bridge lets you adjust your antenna quickly for maximum performance. Measures resonant frequency, radiation resistance and impedance. Continuous range calibrated and expanded capacitance range (1 to 100 pf) gives you much extended measuring range.

Tells resonant frequency and whether to shorten or lengthen your antenna for minimum SWR. Adjust your single or multi-band dipole, inverted vee, beam, vertical, mobile whip or random wire system for maximum performance. 1 to 100 MHz. SO-239 connectors. 2x3x4 inches. 9 volt battery.

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER

$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.

$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

$17.95

NEW

CPO-555 Code Oscillator

For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

$29.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity, 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in.

$54.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying. +300 volts max • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches

$29.95

MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95
MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95

$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatique during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

$49.95

MFJ-1030BX Receiver Preselector

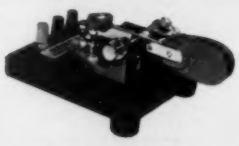
Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches

THE HAM-KEY
NOW 5 MODELS

NEW MODEL HK-5 ELECTRONIC KEYER
$69.95

- Iambic circuit for squeeze keying.
- Self completing dots & dashes.
- Dot memory.
- Battery operated with provisions for external power
- Built-in side-tone monitor.
- Speed, Volume, tone & weight controls.
- Grid-block or direct keying.
- Use with external paddle such as HK-1.

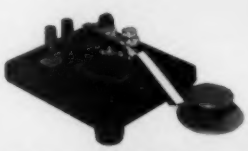


Model HK-1 $29.95

- Dual lever squeeze paddle.
- Use with HK-5 or any electronic keyer.
- Heavy base with non-slip rubber feet.
- Paddles reversible for wide or close finger spacing.

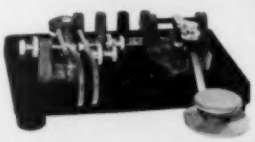
Model HK-2 $19.95

- Same as HK-1, less base for those who wish to incorporate in their own Keyer.



Model HK-3 $16.95

- Deluxe straight key.
- Heavy base, no need to attach to desk.
- Velvet smooth action.



Model HK-4 $44.95

- Combination on HK-1 & HK-3 on same base.

TUFTS RADIO CATALOG — TUFTS RADIO

TUFTS RADIO CATALOG — TUFTS RADIO

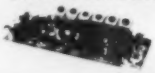
Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

RECEIVERS

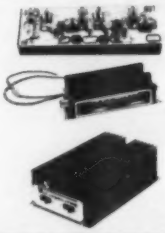
RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	$ 64.95
RX28C W/T	same as above–wired & tested.	117.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	64.95
RX50C W/T	same as above–wired & tested	117.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX114C W/T	same as above–wired & tested	119.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX220C W/T	same as above–wired & tested	117.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	84.95
RX432C W/T	same as above–wired & tested	129.95
RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.95
RF28 Kit	10 mtr RF front end 10.7 MHz out	13.50
RF50 Kit	6 mtr RF front end 10.7 MHz out	13.50
RF144D Kit	2 mtr RF front end 10.7 MHz out	18.50
RF220D Kit	220 MHz RF front end 10.7 MHz out	18.50
RF432 Kit	432 MHz RF front end 10.7 MHz out	29.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	29.50
FM455 Kit	455 KHz IF stage plus FM detector	18.50
AS2 Kit	audio and squelch board	16.00

TRANSMITTERS



TX50	transmitter exciter, 1 watt, 6 mtr.	44.95
TX50 W/T	same as above–wired & tested	64.95
TX144B Kit	transmitter exciter–1 watt–2 mtrs	34.95
TX144B W/T	same as above–wired & tested.	59.95
TX220B Kit	transmitter exciter–1watt–220 MHz	34.95
TX220B W/T	same as above–wired & tested	59.95
TX432B Kit	transmitter exciter 432 MHz	49.95
TX432B W/T	same as above–wired & tested	79.95
TX150 Kit	300 milliwatt, 2 mtr transmitter	24.95
TX150 W/T	same as above–wired & tested	39.95

POWER AMPLIFIERS

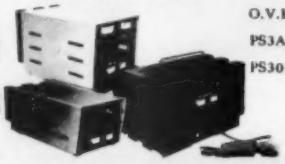


PA2501H Kit	2 mtr power amp–kit 1w in–25w out with solid state switching, case, connectors	64.95
PA4010H Kit	2 mtr power amp–10w in–40w out–relay switching	64.95
PA50/25 Kit	6 mtr power amp, 1w in, 25w out, less case, connectors & switching	54.95
PA144/15 Kit	2 mtr power amp–1w in–15w out–less case, connectors and switching	44.95
PA144/25 Kit	same as PA144/15 kit but 25w	54.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	44.95
PA432/10 Kit	power amp–similar to PA144/15 except 10w and 432 MHz	54.95
PA140/10 W/T	10w in–140w out–2 mtr amp	219.95
PA140/30 W/T	30w in–140w out–2 mtr amp	189.95

Blue Line — RF power amp, wired & tested, emission–CW-FM-SSB/AM

Model	BAND	Power Input	Power Output	
BLC 10/70	144 MHz	10W	70W	149.95
BLC 2/70	144 MHz	2W	70W	169.95
BLC 10/150	144 MHz	10W	150W	259.95
BLC 30/150	144 MHz	30W	150W	239.95
BLD 2/60	220 MHz	2W	60W	164.95
BLD 10/60	220 MHz	10W	60W	159.95
BLD 10/120	220 MHz	10W	120W	259.95
BLE 10/40	420 MHz	10W	40W	179.95
BLE 2/40	420 MHz	2W	40W	179.95
BLE 30/80	420 MHz	30W	80W	259.95
BLE 10/80	420 MHz	10W	80W	289.95

POWER SUPPLIES



PS15C Kit	15 amp–12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	94.95
PS15C W/T	same as above–wired & tested.	124.95
PS25M Kit	25 amp–12 volt regulated power supply w/case, w/fold-back current limiting and ovp, with meter	154.95
PS25M W/T	same as above–wired & tested.	179.95
O.V.P.	adds over voltage protection to your power supplies, 15 VDC max.	12.95
PS3A Kit	12 volt–power supply regulator card with fold-back current limiting	10.95
PS3012 W/T	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection	249.95

REPEATERS

RPT50 Kit	repeater–6 meter	499.95
RPT50	repeater–6 meter, wired & tested	799.95
RPT144 Kit	repeater–2 mtr–15w–complete (less crystals)	499.95
RPT220 Kit	repeater–220 MHz–15w–complete (less crystals)	499.95
RPT432 Kit	repeater–10 watt–432 MHz (less crystals)	579.95
RPT144 W/T	repeater–15 watt–2 mtr	799.95
RPT220 W/T	repeater–15 watt–220 MHz.	799.95
RPT432 W/T	repeater–10 watt–432 MHz.	849.95
DPLA50	6 mtr close spaced duplexer	575.95
DPLA144	2 mtr, 600 KHz spaced duplexer, wired and tuned to frequency	379.95
DPLA220	220 MHz duplexer, wired and tuned to frequency	379.95
DPLA432	rack mount duplexer	319.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.)	25.00
DSC-N	same as above with type N connectors (pr.)	25.00

TRANSCEIVERS

TRX50 Kit	Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals)	244.95
TRX144 Kit	same as above, but 2 mtr & 15w out	234.95
TRX220 Kit	same as above except for 220 MHz	234.95
TRX432 Kit	same as above except 10 watt and 432MHz	254.95
TRC-1	transceiver case only	29.95
TRC-2	transceiver case and accessories	49.95

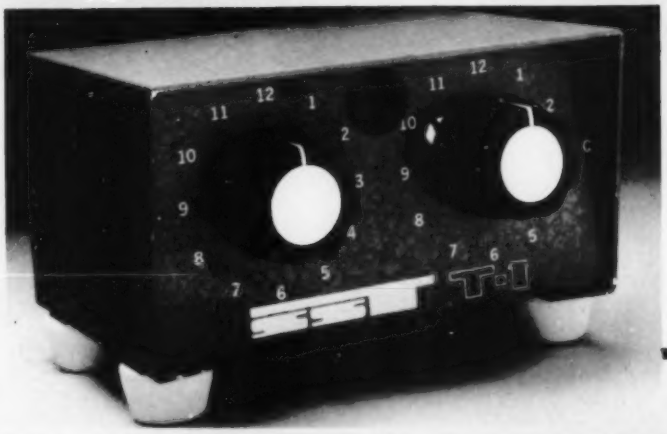
SYNTHESIZERS

SYN II Kit	2 mtr synthesizer, transmit offsets programmable from 100 KHz–10MHz, (Mars offsets with optional adapters)	169.95
SYN II W/T	same as above–wired & tested.	239.95
SYN 220 Kit	same as SYN II Kit except 220-225 MHz	169.95
SYN 220 W/T	same as above–wired & tested	239.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching.	$ 7.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	15.50
CD3 Kit	UHF version of CD1 deck, needed for 432 multi-channel operation.	13.50
COR2 Kit	carrier operated relay.	22.75
SC3 Kit	10 channel auto-scan adapter for RX with priority	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each).	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
MIC 1	2,000 ohm dynamic mike with P.T.T. and coil cord	12.95
TS1 W/T	tone squelch decoder	59.95
TS1 W/T	installed in repeater, including interface accessories	89.95
TD3 Kit	2 tone decoder	35.95
TD3 W/T	same as above–wired & tested	59.95
HL144 W/T	4 pole helical resonator, wired & tested. swept tuned to 144 MHz ban	29.95
HL220 W/T	same as above tuned to 220 MHz ban	29.95
HL432 W/T	same as above tuned to 432 MHz ban	29.95

SST T-1 RANDOM WIRE ANTENNA TUNER



All band operation (160-10 meters) with any random length of wire. 200 watt output power capability—will work with virtually any transceiver. Ideal for portable or home operation. Great for apartments and hotel rooms—simply run a wire inside, out a window, or anyplace available. Efficient toroid inductor for small size: 4-1/4" x 2-3/8" x 3", and negligible loss. Built-in neon tune-up indicator. SO-239 connector. Attractive bronze finished enclosure.

only $29.95

THE ORIGINAL Random Wire Antenna Tuner. . . in use by amateurs for 6 years.

SST T-2 ULTRA TUNER

Tunes out SWR on any coax fed antenna as well as random wires. Works great on all bands (80-10 meters) with any transceiver running up to 200 watts power output.

Increases usable bandwidth of any antenna. Tunes out SWR on mobile whips from inside your car.

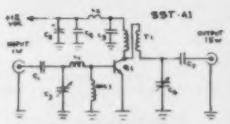
Uses efficient toroid inductor and specially made capacitors for small size: 5-1/4" x 2-1/4" x 2-1/2". Rugged, yet compact. Negligible line loss. Attractive bronze finished enclosure. SO-239 coax connectors are used for transmitter input and coax fed antennas. Convenient binding posts are provided for random wire and ground connections.

only $39.95

only $19.95

SST T-3
Mobile Impedance Transformer

Matches 52 ohm coax to the lower impedance of a mobile whip or vertical. 12-position switch with taps spread between 3 and 52 ohms. Broadband from 1-30 Mhz. Will work with virtually any transceiver—300 watt output power capability. SO-239 connectors. Toroid inductor for small size: 2-3/4" x 2" x 2-1/4". Attractive bronze finish.



only $29.95

$49.95 wire and tested

SST A-1 VHF Amplifier Kit

1 watt input gives you 15 watts output across the entire 2 meter band without re-tuning. This easy-to-build kit (approx. 1/2 hr. assembly) includes everything you need for a complete amplifier. All top quality components. Compatible with all 1-3 watt 2-meter transceivers. Short and open protected—not damaged by high SWR.

Kit includes:

- Etched and drilled G-10 epoxy solder plated board.
- Heat sink and mounting hardware. All components—including pre-wound coils.
- Top quality TRW RF power transistor.
- Complete assembly instruction with details on a carrier operated T/R switch.

GUARANTEE

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VHF Transverters and the FT-101

—quickie FM conversion

Glenn Malme W6OJF
9337 Gotham Street
Downey CA 90241

Converting the popular Yaesu FT-101 series of transceivers in order to provide FM for use with a two meter transverter is a relatively simple job. Similarly, the Yaesu FT-620B six meter SSB, CW, and AM transceiver may be put on FM with the addition of nothing more than a few wires and a single-pole double-throw switch.

The modification of the FT-101 series will allow the user to have NBFM on ten meters and, when coupled with a transverter, to supply drive from the FT-101 for use with 6, 2, 220 or 432 MHz transverters with FM output.

All that this amounts to is that you switch the output of the audio board between its normal position (driving the modulator board) and the clarifier circuit, thus causing the vfo to change frequency in accordance with the superimposed voice frequency.

The surgery consists of wiring in an SPDT switch, as shown in Fig. 1, with a wire going to pin eight on PB-1315 and switching the white wire from pin eight to pin nine on PB-1183. One leg of the switch will have a wire running to the "Clari" pin on PN-1344 on the top of the set. The wire jumpers are accessed from the bottom of the radio.

The switch may be mounted at any convenient location, so don't drill a hole in the front panel. In one position, you have NBFM, and in the other, things are back to normal. When operating FM, you drive your transverter from the ten meter position, and you slope detect in receiving FM on the ten meter position. An AM filter in the FT-101 makes this quite acceptable.

The same basic scheme will allow the six meter FT-620B to generate good quality FM. Again, it consists of coupling the speech amplifier output to the clarifier circuit, so that the vfo is modulated. The mike gain control has to be properly set in both cases to provide anywhere from 3 to 7 kHz deviation.

First you mount a small SPDT switch on the rear apron of the transceiver. In looking at the bottom of the relay socket, the center pin (green wire) is the line that goes to the clarifier. Then lift the center conductor of the red shielded wire from pin 7 of PJ-301. Run two shielded wires to the SPDT switch, as shown in the diagram. Ground the shields, replace the covers, and test. In "normal," the AM, CW, and SSB are unaffected; however, switching to FM on the rear and AM on the front panel will give you 3 to 7 kHz deviation. This mode affects transmit only. Reception must be by slope detection, of course.

By following the diagrams, these simple changes should not present any problem. Be sure to use a small soldering iron in order to do the job properly. FM reception can be achieved by connecting a Signetics 5111A chip to the output of the last i-f stage and feeding it to the audio stage. The use of this chip eliminates slope detection. Instructions come with the chip when it is purchased and can be adapted to any type of AM receiver. ■

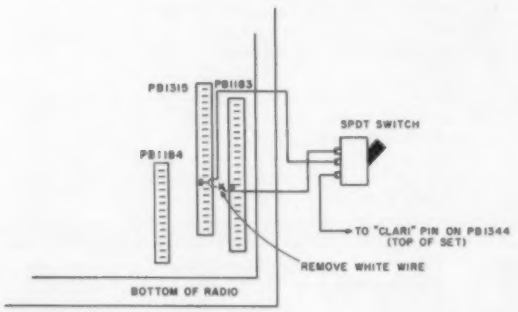

Fig. 1.

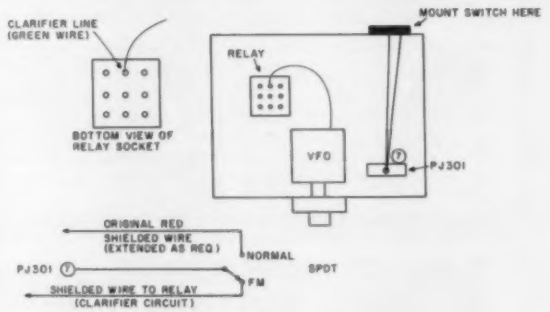

Fig. 2.

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If you can drill a few holes in some junk box materials, that is all the skill you need to fabricate an adjustable keyer paddle. In fact, even drilling can almost be eliminated by some alternative construction methods, if you do not have a well-equipped shop or if your junk box does not contain all the needed items.

The materials you will need for this economy paddle are two pieces of one-sixteenth-inch brazing rod about 4 inches long, 3 one-quarter-inch-diameter by three-quarter-inch-long brass spacer rods that are tapped for machine screws, and whatever pieces of Masonite™, Lucite™, Bakelite™, etc., you choose for the base and the paddles.

Shape the material you have selected for the paddles into a design that is appealing to your eye. A #51 hole should be drilled in the rear edge of the paddles, so they can be glued to the brazing rods. If edge drilling the paddles is too much of a challenge for your limited shop equipment, make the paddles from scraps of copperclad circuit board, and solder the rods to the foil.

The supports for the paddle rods are made by drilling #51 holes about one-quarter inch from one end of two of the brass spacers. A simplified alternative to the drilled spacers is to utilize binding posts that already have a hole drilled for holding wires by turning down a thumbscrew.

The base dimensions are shown in the sketch, but none is critical. Mark a centerline on the base and a spot for the ground post mounting screw about a half inch from the front edge. Locate the paddle rod mounting posts about 1½ inches back from the ground post and to each side of the centerline a distance of one-eighth inch plus the gap you expect to leave between the paddle arms and the ground post. This means that, when the holes are drilled and the components mounted, the paddle arms will be parallel to each other.

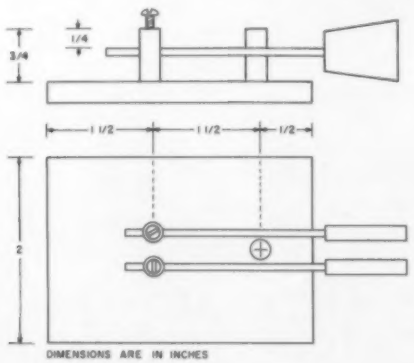

Fig. 1.

If you are using binding posts instead of the brass spacers and you want the paddle arms parallel, you may have to stagger the positions of the fatter posts so they do not touch each other. This, however, should not cause an appreciable difference in sensitivity between the two paddles.

Drill the three holes for the post mounting screws and attach the posts, using a solder lug on each screw for convenience in attaching wires. Insert the paddle rods into the two posts, and tighten the top holding screws. Your paddle is now complete, except for adjusting the contact gap by rotating the paddle posts and obtaining the desired sensitivity by sliding the paddle rods back and forth in the posts. If the desired sensitivity cannot be achieved with the dimensions shown, drill a new hole for the ground post mounting screw about one-quarter inch backward or forward from the original position, depending on whether you want a stiff or pliant action.

Obviously this quickie prototype paddle takes no great prize for aesthetics, and you may want to convert it to a more permanent fixture in your shack. Once you have used it for awhile and determined the length of paddle rods for the preferred sensitivity, solder the rods in the posts and clip off the excess. You can also make adjustment of the paddle rods somewhat easier by soldering a screw head or sawing a screwdriver slot on the top of each of the two paddle posts. If you are concerned about contact resistance, go one step further and silver plate the contact area of the paddle rods and the paddle post. Polish these components and remount them on a heavy steel base finished with wrinkle or hammertone paint and you will have a paddle that has good performance characteristics and is pleasing to the eye as well. ■

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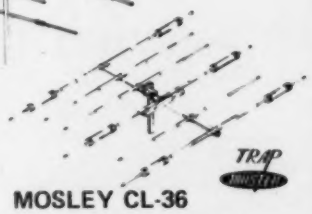

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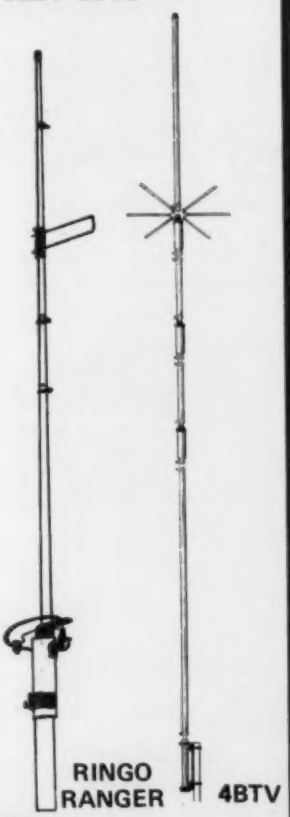

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Watch the Wind!

—*with this junk box anemometer*

While most hams are worrying about their antennas, my concern is my newly hewn wind generator propeller. Since my garage doesn't come close to a machine shop, and my frugal nature abhors expenditure for an air brake or complex feathering device, the natural thing to do is crank down the tower or immobilize the prop for the high winds. But, when you can't spend all of your time in the yard watching the weather or stay awake all night listening, the first step is a wind indicator. Then, if you have a counter and an alarm circuit, you've got the system down pat. Well, the counter alarm comes next, but here's my answer to the indicator. This is an adaptation of one by Hank Olson W6GXN. Almost any small signal NPN transistors will do, and Olson's Electronics (Akron, Ohio) has the Fairchild μL914 for $1.39 (part TR 297). The RTL circuit is a little antiquated but very effective. It is easily mounted on the small printed circuit board from Radio Shack that accommodates the 914 and most of the smaller parts nicely. In case you are thinking of adapting to TTL, the circuit for the μL914 is in Fig. 2.

The wind spinner is made from three small kitchen funnels (49¢ each) attached using a pop-rivet tool. The spinner plate may be cut from 1/16" aluminum plate. A layout drawing (NTS) is in Fig. 3.

The mast can be any type you choose, but aluminum is best since it will not affect the field of the small magnets that pulse the reed switch. This was a small worry for me, however.

The reed switch was mounted in a hole through an expired felt-tip pen. It is offset mounted from the spinner pipe shaft by a bracket to be under and ¼" below the magnets.

Silicone compound from the hardware store filled the holes in the funnels (tips cut off) and weatherproofed the reed switch in its pen mounting. Silicone was found to be better than epoxy for holding the magnets to the aluminum spinner. Epoxy kept weathering loose no matter how clean the aluminum spinner was. An overall mounting detail is provided in Fig. 4.

Try several NPN transistors from your junk box,

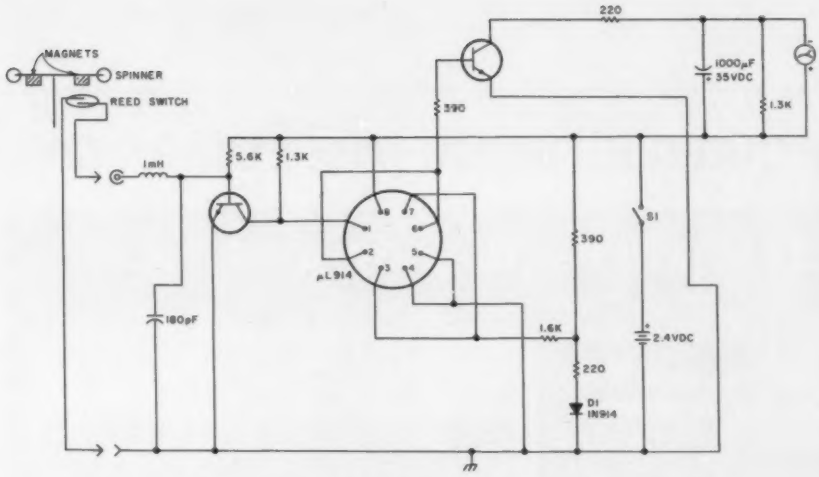


Fig. 1. Adapted from Ham Radio, *June, 1968, p. 52.*

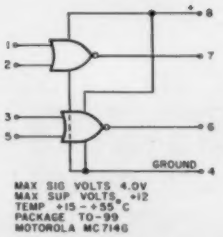


Fig. 2. μL914 detail (or Motorola HEP584).

since some are more responsive than others. The wire connecting the reed switch is your own choice, though coax is probably best. I used speaker wire, expecting to replace it every year or so. Rf induction did not appear to be a problem with the choke inside a 4" x 4" x 5" minibox along with the circuit.

Parts and Assembly

The single greatest problem in this design is the bearing. The original concept was to use a simple teflon bearing similar to the drill stop used for ¼-inch drills. This idea was not satisfactory. A perfect solution was the discovery that a standard (1¼") thin-wall chrome-plated drop pipe for a bathroom sink drain (about 6" long) would accept the standard roller bearing used in the bottom of sliding glass patio doors. Two of these bearings with ¼" center holes fit exactly into the drop pipe. The bottom one stops inside about 3½" down. The top one is held in place with a stainless pipe clamp tightened to hold. These bearings come in a brass version and an aluminum-teflon version. I used the teflon at the bottom and the brass one at the top. A ¼" shaft for the spinner was attached with a sheet-metal screw and "Lock Tite" compound. You may want to use a hole and cotter pin in the bottom of the spinner shaft to keep the spinner from crawling out of the bearing holes at higher speeds. The drop pipe was $1.67, and the bearings were $1.00 each, plus tax. My total investment was less than $6.00, not counting parts from my junk box.

Calibration

I used Hank's technique of a calm Sunday morning, family in auto, father with anemometer protruding over the top of the car from the rear of the station wagon, pencil and paper in hand, and mother driving and calling mph at speeds of 10, 20, 30, 40, 50, and 60. I stopped at 55 and found the relationship linear, and, with the plots for the five points, I extrapolated a curve on some of my daughter's school graph paper. I use the graph, but a scale could be drawn and glued to the meter face.

I'm really pleased with my creation and use it quite often, since the meter sits on top of my antenna coupler. To read it, I just flip the switch, read the meter, and turn off the switch to conserve batteries. It's been in service for more than a year now. ■

References

1. *Ham Radio Magazine*, "An Amateur Anemometer," June, 1968, p. 52.
2. *Ham Radio Magazine*, "An Experimenter's Guide to IC Substitution," September, 1971, p. 28.

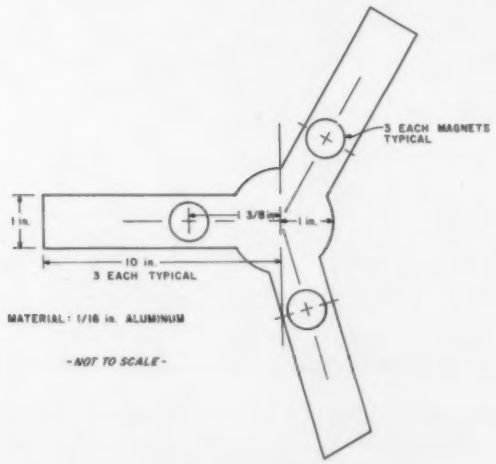
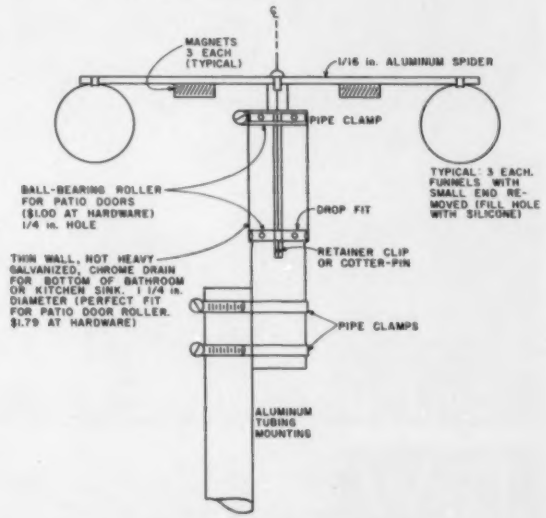


Fig. 3. Spinner details layout.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RETAINER CLIP OR COTTER-PIN
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Fig. 4. Anemometer assembly detail.

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The War Against Rust

—some good news for radio towers

Hams always are on the lookout for new products or new uses for old ones. That's why I was so interested in a recent West Virginia exhibition for coal miners. There were many interesting product exhibits, but one in particular was truly showstopping.

Bruce Weeber, president of Totally Dependable Products, Incorporated, was demonstrating the company's line of lubricants, penetrants, and protectors. Two beautifully finished pistols were installed on a revolving mount, so they could be dipped automatically in a salt water solution about twice a minute. Both weapons had been treated with TDP's "SS 2" Lubricant "Plus." Going around with the pistols were two untreated metal plates. I attended the exhibit on the second of three days, and the untreated plates were well rusted. Neither of the pistols showed any sign of rust or corrosion.

Weeber told me that even after days of such abuse, "SS 2"-treated metal isn't rusted or damaged. He showed me a variety of products with slightly different chemistry for different applications. I carried home sample cans of the "SS 2" Lubricant "Plus" and "SS P" Super Penetrant ("If you put that on a frozen nut, stand back so you won't be hit by flying metal," Weeber jokes) for some tough tests other sprays had failed.

First I tried a little experiment. I used a sander on my electric drill to buff clean four high-carbon hex-head cap screws, and I arranged them on a piece of ½-inch Styrofoam®, as in Photo A. I treated the first with "SS 2," the next one with "WD-40," the third with General Electric Silicone Lubricant, and left the fourth one untreated. The whole arrangement went outside in a drizzling rain. After only three hours, the untreated screw head was almost completely rusted over. The GE Silicone-treated screw was showing signs of rust. The other two still were bright and shiny. At five hours, the silicone-treated screw head was definitely rusting, but the "WD-40" and "SS 2" had maintained their protective coatings.

After 48 hours, it was still raining. Both the untreated and silicone-treated screw heads were solidly rusted. Rust spots had appeared on the "WD-40" screw, but the "SS 2"-treated screw head still was clear. Rust spots finally were visible on the "SS 2" screw after 72 hours.

Next I wiped the "SS 2" and "WD-40" screw heads clear of moisture and reapplied coatings of protective film. Eight days later there had been no noticeable change in either screw (see Photo B), so, apparently, both "WD-40" and "SS 2" give pretty good static moisture protection with maybe a slight edge going to the "SS 2" in light of the few hours of extra protection it gave in the beginning.

Next I tried some more practical tests. I've been looking for years for an all-weather, long-lasting, non-gumming lubricant for my bicycle chain. I had tried 'WD-40" and "LPS-3," but, in damp weather, daily applications were a must. The "SS 2," however, soon proved itself. I ride through rain, mud, and grime, making frequent cleaning necessary. But with the TDP lubricant, I don't

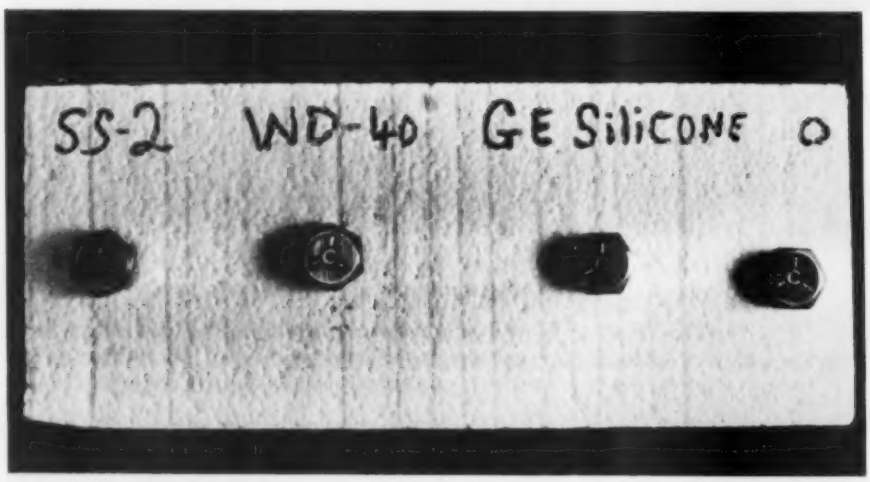

Photo A. The screw heads after cleaning but before treatment with any lubricant/protective film.

have to worry about rust, and the time between cleanings is longer.

I've carried a pocketknife for years, and I've always believed in nonstainless steel blades. But that presents another problem: rust due to pocket moisture. Regular cleanings at short intervals have been my practice. I've found that treating the knife first with "SS P" to clean off everything and then spraying on "SS 2" about once a month will keep my knife blades clean and bright.

I'm finding many ham shack applications for "SS 2," which seems to be the best general-purpose product. Feeler gauges, pliers, wrenches, and other tools prone to rust stay clean a lot longer, even under heavy use, with an "SS 2" coating. It keeps nails, screws, and other hardware bright and clean before and after use and prevents fingerprint tarnish on equipment chassis and circuit boards. The darn stuff seems to fill about any lubricating/protecting need you can think of.

The TDP line is varied, each formula slightly different for specific needs. For example, "SS 1" is primarily a penetrant, designed to loosen frozen parts and dislodge grease, dirt, light rust, and tar. It has the "plus" of leaving a light (0.04 mil) dry lubricating and protective film. "SS 2," on the other hand, is primarily a lubricant. It still has penetrating power, but it has four times the lubrication and protection of "SS 1." Both products are nonconductive and are harmless to metals, wood, rubber, painted surfaces, and "most plastics." So far I haven't noticed that the "SS 2" has harmed any plastics. And there's "SS P" which has even more penetrating power than "SS 1."

I've noted a few of the TDP products in Table 1. My personal experience is limited to "SS P" and "SS 2," but reports from other users tell me the various preparations are equally reliable. Everyone who uses the products becomes an immediate convert, as did Bruce Weeber. He is an accountant by training and trade, but jumped on the bandwagon when chemist Earle Bidgood, developer of the original formula, first showed him the product. TDP apparently is a new company, and the products may not be widely distributed through retail outlets. You can get more information from Totally Dependable Products, 513 High Street, Pottstown, Pennsylvania 19464. ■

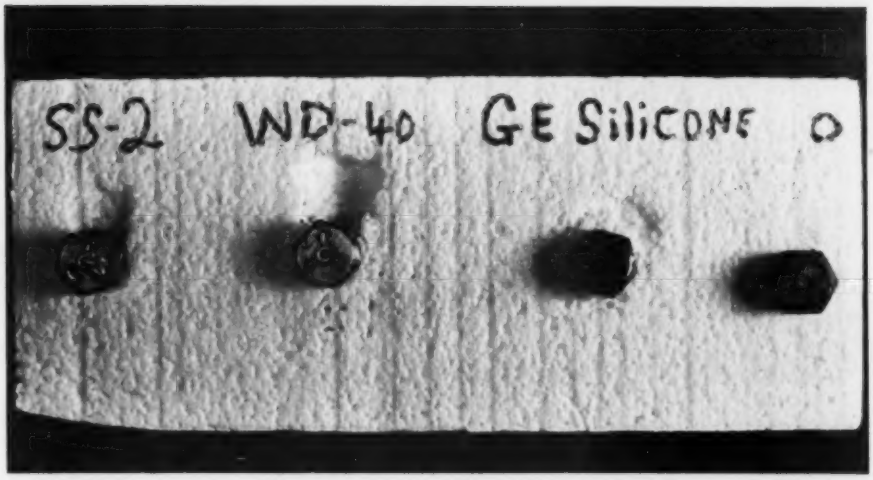

Photo B. The experiment after 11 days. Rust spotting is evident on both "SS 2"-and "WD-40"-treated screw heads, but the spots showed up under the "SS 2" coating at least 24 hours later than on the "WD-40" treated screw. Both products appear to offer adequate protection against spreading rust. I stepped on the experiment on the last day, causing the impressions under the "SS 2" and "WD-40" screws. The dimpling around the silicone-treated screw, however, was caused by the spray itself; it "melted" the Styrofoam®.

"SS 1"	Penetrant "Plus"
"SS 2"	Lubricant "Plus"
"SS P"	Super penetrant
"OR 1"	Rust remover
"RS 2"	Rust stopper
"PE 1"	Precision electrical cleaner (volume controls, tape heads, relays, etc.)
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Table 1. Most TDP products come as aerosol sprays at about $2.25 for 6 ounces. Twelve-ounce, gallon, five-gallon, and 55-gallon sizes also are available. All products are nonconductive and generally safe to use on electrical circuits.

Photo C. Handy 2-ounce spray cans of TDP chemicals also are available. This size fits nicely in a tool box, bicycle bag, or glove compartment. A plus for many applications, these sprays don't produce the usual fine mist, but rather a powerful stream of lubricant which gets where it's needed in a hurry.

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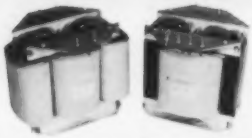

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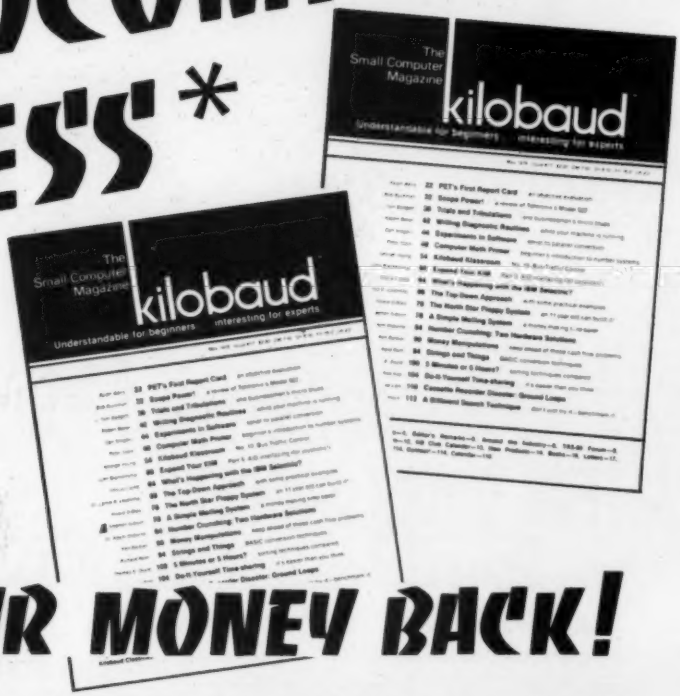

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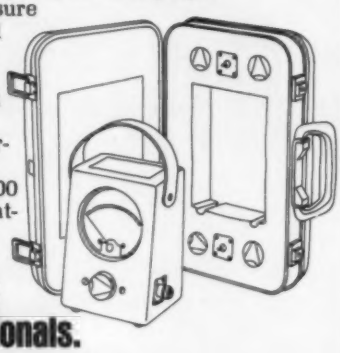

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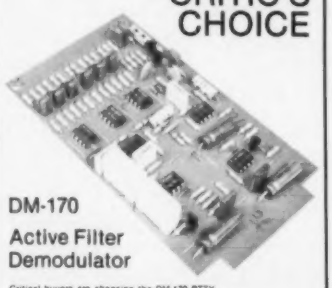

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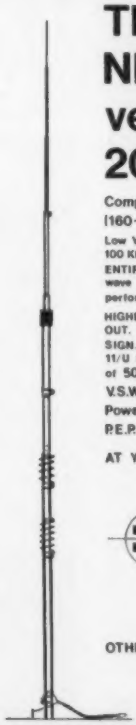

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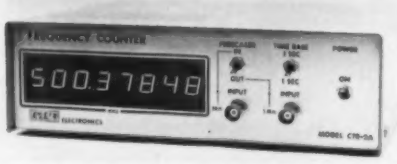

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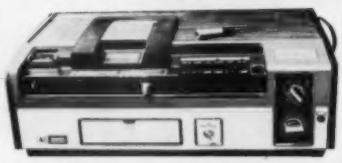

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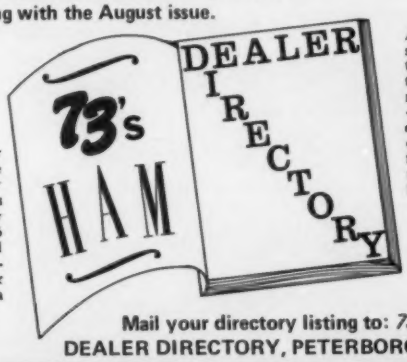

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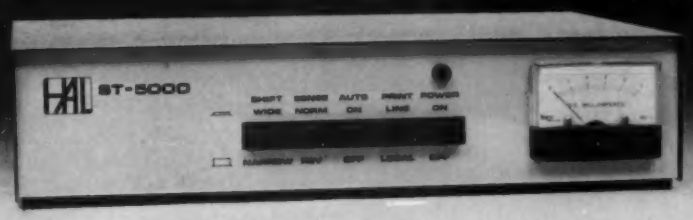

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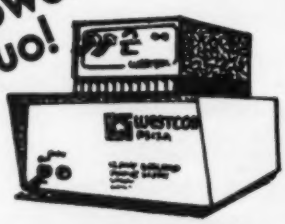

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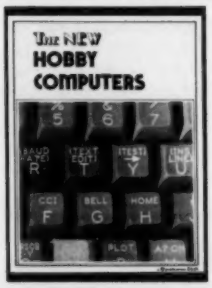

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PART 97—AMATEUR RADIO SERVICE

Increase in the Frequencies Available for Use by General Class Amateur Radio Operators

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: The FCC is amending its amateur radio rules to permit General Class operators to operate their stations between 50.0 MHz and 50.1 MHz. We are taking this action in order to give General Class operators the same privileges as Technician Class operators in the very high and ultra high frequency bands.

EFFECTIVE DATE: May 15, 1978.

ADDRESS: Federal Communications Commission, 1919 M Street NW., Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Mr. Gregory M. Jones, Personal Radio Division, 202-634-6619 (Not a toll-free telephone number).

SUPPLEMENTARY INFORMATION:

ADOPTED: April 20, 1978.

RELEASED: May 3, 1978.

Order. In the matter of increase in the frequencies available for use by General Class amateur radio operators.

1. This Order makes all authorized amateur operating privileges available to General Class amateur radio operators between 50.0 MHz and 50.1 MHz.

2. On March 22, 1978 the Commission adopted a Second Report and Order in Docket 20282. The Second Report and Order (1) Made the Novice Class amateur operator license valid for a period of five years and renewable[1] and (2) extended full amateur operating privileges to Technician Class amateur operators above 50.0 MHz. The new rule amendments were given an effective date of May 15, 1978.

3. It has come to our attention that in making 50.0 MHz to 50.1 MHz available to Technician Class licensees, we may have acted unfairly towards General Class licensees, who are prohibited from operating their amateur stations between 50.0 MHz and 50.1 MHz.[2] Since the General Class license is more difficult to obtain than the Technician Class license, it does not appear reasonable to afford Technician Class licensees greater operating privileges than General Class licensees. Indeed, one of the principles upon which the current amateur licensing system is based is that each successively "higher" amateur operator license conveys all operating privileges of all "lower" class operator licenses. The Rules as amended by the Second Report and Order in Docket 20282, are anomalous: a licensee "upgrading" the class of his operator license from Technician to General would lose the privilege of operating between 50.0 MHz and 50.1 MHz.

4. We believe General Class licensees should have all privileges afforded Technician Class licensees. Accordingly, we are amending Section 97.7 of the rules to make 50.0 MHz to 50.1 MHz available to General Class licensees.

5. Authority for this action, which we believe to be in the public interest, is contained in sections 4(i) and 303 of the Communications Act of 1934, as amended. Because the amendment we are adopting is minor in character, merely increasing slightly the frequencies available for the use of General Class amateur radio operators, we find, for good cause, that the prior notice and public procedure provisions of the Administrative Procedures Act, 5 U.S.C. 553, are unnecessary.

6. For the foregoing reasons, the Commission orders amendment of Part 97 of its rules, as such attached below effective May 15, 1978.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082; (47 U.S.C. 154, 303).)

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

The FCC is amending Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations, as follows:

1. Section 97.7(a) is amended to read, as follows:

§ 97.7 Privileges of operator licenses.

(a) *Amateur Extra Class and Advanced Class.* All authorized amateur privileges including exclusive frequency operating authority in accordance with the following table:

Frequencies	Class of license authorized
3500-3525 kHz	Amateur extra only.
3775-3800 kHz	Do.
7000-7025	Do.
14,000-14,025 kHz	Do.
21,000-21,025 kHz	Do.
21,250-21,270 kHz	Do.
3500-3800 kHz	Do.
7150-7225 kHz	Amateur extra and advanced.
14,200-14,275 kHz	Do.
21,270-21,350 kHz	Do.

[1]The Novice Class operator license had been valid for a period of two years and was not renewable.

[2]Section 97.7(a) of the Commission's Rules limits operation between 50.0 MHz and 50.1 MHz to Amateur Extra Class and Advanced Class operators.

PART 97—AMATEUR RADIO SERVICE

Editorial Amendments Concerning Novice Class Amateur Radio Operators

AGENCY: Federal Communications Commission.

ACTION: Editorial rule amendments.

SUMMARY: The FCC is amending its amateur radio rules to bring them into conformity with action the FCC took in March 1978. In a report and order adopted in March 1978 the FCC made the novice class amateur radio operator license valid for a 5-year term and renewable. At that time only the rule about renewability was amended, however. This order amends the rule about the term of the novice class license.

EFFECTIVE DATE: May 15, 1978.

ADDRESS: Federal Communications Commission, 1919 M Street NW., Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Mr. Gregory M. Jones, Personal Radio Division, 202-634-6619.

SUPPLEMENTARY INFORMATION:

Adopted: April 11, 1978.

Released: April 12, 1978.

1. On March 22, 1978, the Commission adopted a second report and order in Docket 20282. In the second report and order the Commission, among other things, said it was amending its rules to make the novice class amateur operator license valid for a period of 5 years and renewable. The novice class operator license had previously been valid for a period of 2 years and was not renewable. The new rules were given an effective date of May 15, 1978.

2. The second report and order in Docket 20282 amended § 97.13 of the rules to state that all amateur operator licenses could be renewed upon proper application. Regulations concerning the license terms of amateur licenses are contained in § 97.59 of the rules, however. This order amends § 97.59 of the rules to implement the Commission's express intention in Docket 20282; namely, that all amateur licenses, including those issued to novice class operators, are normally to be valid for 5 years from the date of issuance or renewal.

3. Since the amendment we are adopting is editorial in character, merely amending the rules to ensure their conformity with prior Commission action, the prior notice and public procedure provisions of the Administrative Procedures Act, 5 U.S.C. 553, are not applicable. Authority for this action appears in sections 4(i), 5(d), and 303 of the Communications Act of 1934, as amended.

4. Accordingly, it is ordered that § 97.59 of the Commission's rules is amended as set forth below effective May 15, 1978.

(Secs. 4, 5, 303, 48 Stat., as amended, 1066, 1068, 1082; 47 U.S.C. 154, 155, 303.)

FEDERAL COMMUNICATIONS COMMISSION,
RICHARD D. LICHTWARDT,
Executive Director.

Part 97 of chapter I of Title 47 of the Code of Federal Regulations is amended, as follows:

1. § 97.59 (a) and (b) are amended to read, as follows:

§ 97.59 License term.

(a) Amateur operator licenses are normally valid for a period of 5 years from the date of issuance of a new or renewed license.

(b) Amateur station licenses are normally valid for a period of 5 years from the date of issuance of a new or renewed license. All amateur station licenses, regardless of when issued, will expire on the same date as the licensee's amateur operator license.

PART 97—AMATEUR RADIO SERVICE

Operator Classes, Privileges, and Requirements in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: The FCC is amending its Amateur Radio Service rules to make all amateur frequencies above 50 MHz available to Technician Class amateur operators and to make the Novice Class amateur operator license renewable and valid for five years. We are taking this action to give Technician Class operators more flexibility in their operations and to make it easier for Novice Class operators to remain licensed amateur operators. We expect our action will result in both more efficient use of the spectrum above 50 MHz by amateur operators and an increase in the number of Novice Class amateur operators.

EFFECTIVE DATE: May 15, 1978.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Joseph M. Johnson, Personal Radio Division, Safety and Special Radio Services Bureau, 202-632-7250 (This is not a toll-free telephone number.)

SUPPLEMENTARY INFORMATION:

Adopted: March 22, 1978.

Released: April 6, 1978.

By the Commission: Commissioner White dissenting.

In the matter of amendment of Part 97 of the Commission's Rules concerning operator classes, privileges, and requirements in the Amateur Radio Service (41 FR 25013).

Docket No. 20282; RM-1016, 1363, 1454, 1456, 1516, 1521, 1526, 1535, 1568, 1572, 1602, 1615, 1629, 1633, 1656, 1724, 1793, 1805, 1841, 1920, 1947, 1976, 1991, 2030, 2043, 2053, 2149, 2150, 2162, 2166, 2216, 2219, 2256, 2284, 2449; FC 78-212.

1. On December 16, 1974, the Commission released a Notice of Proposed Rulemaking in this proceeding which was published in the FEDERAL REGISTER on December 20, 1974 (39 FR 44042). A First Report and Order was released on June 15, 1976 (41 FR 25013). This Second Report and Order is a further step in the resolution of the very complex and far reaching proposals of the Notice.

2. In the Notice, the Commission proposed to expand the frequencies available to Technician Class licensees. Presently, Technicians may operate in the bands 50.1-54.0 MHz, 145-148 MHz, and on all amateur frequencies above 220 MHz. The proposed rules would have permitted operation on all amateur frequencies above 50 MHz. This proposal was supported by the American Radio Relay League (ARRL) in its comments, and by numerous individual amateurs.

3. In light of actions now being taken in Docket 21033 concerning frequencies available for repeater station use, we believe the time has come to grant expanded frequency privileges to Technicians. Specifically, we will amend Section 97.7(d) of the Amateur Radio Service Rules to permit Technician Class licensees to operate on all frequencies above 50 MHz. We believe this action will give greater flexibility to such licensees who wish to do experimental and weak-signal work in the 50 MHz and 144 MHz bands.

4. In Docket 20282 the Commission also proposed to make the Novice Class operator license, which is currently a two year non-renewable license, a five year renewable license. There was strong support for this proposal in the comments, and we are adopting it as proposed. We are amending Section 97.13 of the Rules accordingly. Licensees now holding Novice Class licenses may renew them upon proper application.

5. In view of the foregoing, we believe that the amended rules, as discussed above, are in the public interest. Accordingly, pursuant to authority contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended, it is ordered that Part 97 of the Commission's Rules is amended as set forth in the attached Appendix. It is further ordered that this proceeding is continued. The rule amendments adopted herein become effective May 15, 1978.

(Secs. 4, 303, 48 Stat., as amended, 1066, 1082; 47 U.S.C. 154, 303.)

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended, as follows:

1. § 97.7(d) is amended to read, as follows:

§ 97.7 Privileges of operator licenses.

* * * * *

(d) *Technician Class.* All authorized amateur privileges on the frequencies 50.0 MHz and above. Technician Class licenses also convey the full privileges of Novice Class licenses.

* * * * *

2. In § 97.13, paragraph (b) is deleted, paragraphs (c) through (f) are redesignated paragraphs (b) through (e), and paragraph (a) is amended, as follows:

§ 97.13 Renewal or modification of operator license.

(a) An amateur radio operator license may be renewed upon proper application.

PART 97—AMATEUR RADIO SERVICE

Simplification of the Licensing and Call Sign Assignment Systems in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: The FCC is eliminating the availability of special call signs prefixed by the letters "WR" for stations in repeater operation in the Amateur Radio Service. We think each amateur radio operator should have one station license and one call sign.

"WR" call signs are unnecessary. We expect the elimination of "WR" call signs for stations in repeater operation will have no significant effect on operations conducted in the Amateur Radio Service.

EFFECTIVE DATE: Non-Applicable.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Gregory M. Jones, Personal Radio Division, Safety and Special Radio Services Bureau, 202-634-6619. (This is not a toll-free telephone number.)

SUPPLEMENTARY INFORMATION:

Adopted: March 22, 1978.

Released: April 6, 1978.

By the Commission: Commissioner White dissenting.

In the matter of the simplification of the licensing and call sign assignment systems in the Amateur Radio Service (43 FR 7332).

What is the Background of This Proceeding?

1. In a Notice of Proposed Rulemaking in Docket 21135, released March 11, 1977, 42 FR 15438 (1977), the Commission acted on its own initiative and proposed several major revisions of its Amateur Radio Service regulations, 47 CFR § 97.1, et seq. Comments on our proposals were due no later than June 2, 1977. Reply comments were due no later than June 30, 1977. The American Radio Relay League, Incorporated (ARRL) petitioned for an additional thirty days in which to submit comments and reply comments. On May 19, 1977 the Chief, Safety and Special Radio Services Bureau, acting under delegated authority, denied the ARRL's petition, stating that the eighty-three day comment period the Commission provided was adequate, and that rapid resolution of the issues raised in the Notice of Proposed Rulemaking in Docket 21135 was essential.

2. In the Notice of Proposed Rulemaking in Docket 21135 we proposed to simplify greatly the licensing and call sign assignment systems in the Amateur Radio Service. We proposed to discontinue the issuance of all amateur station licenses, except primary station licenses and space station licenses. Specifically, we proposed to eliminate Radio Amateur Civil Emergency Service (RACES) stations, special event stations, club stations, military recreation stations, secondary stations, repeater stations, auxiliary link stations and control stations. We also proposed to amend the Amateur Service rules to state that all amateur station call signs would be assigned on a systematic basis. As part of our call sign proposal, we proposed to eliminate the availability of distinctive call signs for repeater stations (call signs prefixed by the letters "WR") and RACES stations (call signs prefixed by the letters "WC").

3. The Commission adopted a First Report and Order in Docket 21135 on February 8, 1978. In the First Report and Order the Commission eliminated the availability of secondary stations and special event stations. We also amended the amateur rules to eliminate existing special call sign programs. We did not adopt our proposal to eliminate separate club, military recreation and RACES station licenses. Instead, we proposed to adopt new rules restricting the eligibility for such licenses. We did not act at all on our proposals to eliminate repeater, auxiliary link and control stations licenses or to eliminate the availability of distinctive call signs for repeater stations.

4. Our proposals to eliminate separate repeater, auxiliary link and control station licenses duplicated a proposal we made in a Notice of Inquiry and Notice of Proposed Rulemaking in Docket 21033, 42 FR 2089 (1977). In a Report and Order in Docket 21033, released September 27, 1977, FCC 77-651, the Commission amended its rules to eliminate the availability of repeater, auxiliary link and control station licenses. On November 4, 1977 these regulations were stayed pending disposition of several petitions requesting reconsideration of our action in Docket 21033. In a Memorandum Opinion and Order in Docket 21033, also adopted today, we are affirming our original decision to delete the availability of repeater, auxiliary link and control station licenses. Further discussion of these issues in connection with this proceeding is therefore not necessary. Rather, we will consider the one remaining unaddressed issue in Docket 21135, namely, "WR" call signs for stations in repeater operation.

What Were Our Specific Proposals and Why Did We Make Them?

5. In our Notice of Proposed Rulemaking in Docket 21135 we proposed to eliminate the availability of station call signs prefixed by the letters "WR" for stations in repeater operation. We made this proposal, which involves a change in Commission policy rather than an amendment to a specific rule, to bring our regulatory programs into closer alignment with our existing resources. We said we could discern no compelling reason to continue our complex system of call sign assignment in the Amateur Service, a system which requires an allocation of our limited resources sufficient to degrade significantly the services we offer to amateur licensees in other areas. We indicated that we were aware that our proposal in Docket 21135 to eliminate the availability of "WR" call signs entirely conflicted with a proposal we made in Docket 21033 to make "WR" call signs available in certain instances to stations in repeater operation.[1] We concluded that our proposal to eliminate "WR" call signs, when taken with our other call sign proposals, would, if adopted, "result in a simpler and fairer call sign assignment system and would permit us to concentrate our * * * resources on areas more productive for the Amateur Radio Service."

What Did the Comments Say?

6. The majority of those commenting on our proposed simplification of the amateur station call sign system did not address the question of the elimination of "WR" call signs for stations in repeater operation. Rather, most respondents focused their comments on other aspects of the call sign proposals, such as the proposals to eliminate the provisions of the rules which permitted former holders of specific call signs to reacquire those call signs and which permitted licensees holding so-called "preferred" call signs (i.e., call signs consisting of one or two letters, followed by one digit, followed by two letters, or call signs consisting of one letter, followed by one digit, followed by three letters) to retain preferred call signs when changing their station locations from one call sign region to another call sign region.

7. The comments about the proposed elimination of "WR" call signs were, for the most part, negative. Although we cannot discuss each comment individually, because of the number we received, the following were representative of the arguments advanced against the elimination of "WR" call signs:

a. Programming of automatic identification equipment to transmit the call sign of a station in repeater operation would be difficult, particularly if the call signs of more than one amateur stations are to be used for identifying the station placed in repeater operation.

b. No one would be willing to "lend" his primary station call sign to a station in repeater operation, since to do so would make the person "lending" his call sign responsible for the transmissions of all users of the station in repeater operation, including those transmissions which violate the Commission's rules.

c. Many amateur licensees travel extensively around the United States. In order to make effective use of existing repeater stations, amateur licensees who travel must use published directories listing repeater stations in operation. Elimination of "WR" call signs would diminish the utility of such directories and make operation away from home more difficult for amateur licensees.

d. The call signs of existing repeater stations are well known. To eliminate distinctive call signs for repeater stations would unnecessarily complicate repeater operation.

e. It is important in situations involving interference to or from a station in repeater operation that the station in repeater operation be readily identifiable. To eliminate "WR" call signs should make identification and location of stations in repeater operation more difficult than it is today.

What Action Are We Taking and Why?

8. We have carefully reviewed all the comments we received addressing the issue of "WR" call signs for stations in repeater operation, and have concluded that the arguments against elimination of "WR" call signs, although far from frivoulous, are outweighed by other, more compelling considerations, namely, the extension of the principle adopted in the First Report and Order that each amateur operator should have *one* station license and *one* station call sign. Accordingly, we will no longer issue "WR" call signs to stations in repeater operations.[2] Licensees of stations with "WR" call signs will not be permitted to retain those call signs after the expiration of their station licenses.

9. In eliminating the availability of "WR" call signs for stations in repeater operation, we emphasize our firm belief that our action will not adversely affect operations conducted in the Amateur Service. The elimination of "WR" call signs, taken in connection with our simultaneous elimination of separate licenses for repeater stations in Docket 21033, means that any station may be placed in repeater operation, using its existing call sign, without prior Commission authorization. Amateur stations were operated as repeater stations for many years before the Commission adopted regulations governing the licensing and operation of repeater and associated stations in Docket 18803, 37 FCC 2d 225 (1972). Thus, until little more than five years ago, the Commission had issued no "WR" call signs whatsoever. Moreover, the Commission's decision in 1972 to require separate licenses and call signs for stations in repeater operation was not particularly well received by the amateur community at that time. We found it odd, to say the least, that there is now so much opposition to action which just five years ago would have been overwhelmingly approved by amateur licensees. In sum, what we are doing in this proceeding and in Docket 21033 is to relieve unnecessary restrictions on amateur licensees, to make it easier for amateurs to place stations in repeater operation, and to relieve the Commission of an administrative burden which has proven to be unnecessary.[3]

10. We do not think the arguments against eliminating the availability of "WR" call signs are persuasive.

a. Programming of automatic identification equipment to transmit primary, secondary or club station call signs, instead of "WR" call signs, should not present licensees with a significant problem. Indeed, after the Commission adopted new repeater operations regulations on September 1977, but before those regulations were stayed in November 1977, many amateurs prepared to place new stations in repeater operation. We are not aware of such substantial difficulty encountered by the licensees of such stations in programming their automatic identifiers to transmit non-"WR" call signs, although it has been brought to our attention that some automatic programming equipment cannot retain all the characters (e.g., WB6XXX/RPT) our rules require to be transmitted as station identifying by stations in repeater operation.[4]

b. We believe the contention that no one would be willing to permit his primary station call sign to be used by a station in repeater operation has no merit. It is true that the licensee of such a station would be responsible for all transmissions of the station, including those in violation of our rules; however, the licensee is always responsible for the proper operation of his station, whether or not it has a "WR" call sign. If an existing repeater station is affiliated with a club, the station trustee is legally responsible for the station's transmissions. If a repeater station is licensed to an individual amateur, he is as responsible for the proper operation of the repeater station as he is for the proper operation of his primary station. In this regard, whether a station is assigned a "WR" call sign or not makes no legal difference whatsoever. The licensee is *always* responsible for the proper operation of his station.

c. We are aware that many amateurs travelling around the United States make use of open-access repeater stations when they are away from home. We are also aware that amateurs who are away from home rely frequently on published repeater directories to determine the frequencies and call signs of repeater stations in various parts of the country. We do not believe, however, that elimination of the availability of "WR" call signs will significantly affect the utility or reliability of repeater directories. Nor do we believe that elimination of "WR" call signs will make it more difficult for amateurs travelling away from home to make use of stations in repeater operation. We presume that the frequencies used by new stations placed in repeater operation, without "WR" call signs, will be coordinated as they have been in the past, with amateur repeater councils. We further presume that most new stations placed in repeater operation will, upon successful frequency coordination, be listed in the various published repeater directories, in the same way a station with a "WR" call sign is listed. The absence of a "WR" call sign simply makes no difference from an operational standpoint.

d. It may be true that the call signs of some existing repeater stations are well known. We do not believe, however, that elimination of "WR" call signs for stations in repeater operation would cause much, if any, confusion. Firstly, most amateur operators are accustomed to dealing with many different call signs in their everyday operations. Amateur operators will, we believe, experience no difficulty adapting to new call signs for stations in repeater operation. Secondly, and more importantly, it has been our experience that many amateurs are, for the most part, unaware of repeater station call signs, or, if they are aware, tend to downplay their significance. That is, most amateurs place much greater importance on the frequencies on which a repeater station operates than on the call sign of a repeater station. For example, most amateur operators would refer to WR3XXX, operating on 146.31 MHz/146.91 MHz, not as WR3XXX, but as the "31/91 machine." Our respondents in this proceeding therefore appear to have greatly overemphasized the importance of "WR" call signs for stations in repeater operation.

e. We agree that it is very important in cases in which a station in repeater operation causes radio frequency interference that it be easy to identify and locate the station in repeater operation. We do not believe, however, that a "WR" call sign makes any perceptible difference one way or the other in the resolution of interference complaints. If a station is in repeater operation with a non-"WR" call sign and is causing interference, it should be no more difficult to contact the licensee than if a station with a "WR" call sign were causing the interference.

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[1] In both our Notice of Proposed Rulemaking and Report and Order in Docket 21033 we recognized the desirability, both from the user's standpoint and the enforcement standpoint, of providing a mechanism by which one monitoring a frequency knows whether or not he is listening to a station in repeater operation. We adopted a rule requiring a station in repeater operation to transmit either the letters "R" or "RPT" or the word "repeater" after the station call sign when identifying.

[2] The processing of repeater station licenses has been "frozen" since September 21, 1977. The last "WR" call sign has, therefore, already been issued.

[3] In this connection, we refer the reader to paragraphs 7-9 of our First Report and Order in this proceeding, in which we indicate that elimination of all special call sign programs will have a substantial beneficial effect on the efficiency of our amateur processing system.

[4] In Docket 21033 we are amending our identification rule to permit licensees employing telegraphy for identification to append *either* "R" *or* "RPT" to their station call signs.

The mailing address of the licensee and the station's location are contained in Commission records both for stations with "WR" call signs and stations without "WR" call signs. Resolution of interference complaints would, therefore, not be made any more difficult by permitting stations in repeater operation to use non-"WR" call signs.

Conclusion

11. In conclusion, we have shown that the issuance of "WR" call signs constitutes an unnecessary drain on our limited resources, that elimination of "WR" call signs will have no significant effect on amateur repeater operations, and that the arguments of those objecting to the elimination of "WR" call signs are without merit. Accordingly, we order that no new "WR" are to be issued. Licensees now assigned "WR" call signs may continue to use those call signs until the expiration dates of their station licenses. (We note that stations assigned "WR" call signs are exempt from the station identification requirements of Section 97.84(d)(1) of the Rules.)

12. We are continuing Docket 21135.

Federal Communications Commission,
William J. Tricarico,
Secretary.

PART 97—AMATEUR RADIO SERVICE

Deregulation of Rules To Simplify the Licensing and Operation of Complex Systems of Stations and Modify Repeater Subbands in the Amateur Radio Service

AGENCY: Federal Communications Commission.

ACTION: Final rules.

SUMMARY: The FCC is amending its Amateur Radio Service rules to eliminate the availability of repeater, auxiliary link, and control station licenses. We are also making several other changes in the rules governing the operation of repeater and associated stations. We are taking this action in response to several petitions requesting that we reconsider action we had originally taken in September 1977. We expect our action will make it much easier for amateur operators wishing to place their stations in repeater operation to do so.

EFFECTIVE DATE: May 15, 1978.

ADDRESS: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

Robert Cassler, Personal Radio Division, Safety and Special Radio Services Bureau, 202-634-6620. (This is not a toll-free number.)

SUPPLEMENTARY INFORMATION:

Adopted: March 22, 1978.

Released: April 6, 1978.

By the Commission: Commissioner White dissenting.

In the matter of deregulation of part 97 of the Commission's rules to simplify the licensing and operation of complex systems of stations and modify repeater subbands in the Amateur Radio Service.

1. The Commission has before it eight petitions for reconsideration of the action it took in Docket 21033 on September 21, 1977. These petitions were filed by the American Radio Relay League, Newington, Conn.; Robert Bingham, Elgin, Ill.; Laurent J. Blouin, Derry, N.H.; The Chicago FM Club, Arlington Heights, Ill.; Corwin D. Moore, Jr., on behalf of the Michigan Area Repeater Council, Ann Arbor, Mich.; Joseph H. Reisert, Jr., of Chelmsford, Mass.; The San Antonio Repeater Organization (SARO), San Antonio, Tex.; and Paul Wade, Somerville, N.J., all according to section 1.429 of the Commission's rules.

Background

2. The Commission proposed in a notice of inquiry and notice of proposed rulemaking in Docket 21033, released January 6, 1977 (42 FR 2089), to substantially change many of the rules governing the licensing and operation of repeater stations and associated stations in the Amateur Radio Service. We proposed at that time to end the separate licensing of repeater, auxiliary link, and control stations, to open up nearly all amateur bands for repeater operations and to reduce the station identification and logging requirements for repeater operation. These proposals were in furtherance of the Commission's policy of deregulation of the Amateur Radio Service, and simplification of licensing of Amateur radio stations. The Commission also cited progress amateurs had made toward self-regulation in the operation and development of complex systems of stations.

3. Final regulations in Docket 21033 were adopted by the Commission, and released September 27, 1977 (42 FR 52418). In this action, the Commission changed the amateur rules to allow amateurs to operate repeaters without requiring a separate license. It opened all frequencies above 220 MHz to repeater operation (except for 435-438 MHz) and added 144.5 to 145.5 MHz as a repeater subband in the 144-148 MHz amateur band. The Commission increased Technician Class operating privileges to include this new repeater subband. Logging and station identification requirements were relaxed. The Commission said that elimination of separate repeater, auxiliary link and control stations will enable it to provide the public with better service in processing primary station and operator license applications.

4. The Commission received eight petitions to reconsider the rule changes adopted in Docket 21033. The rule changes were to have taken effect on November 4, 1977. However, the American Radio Relay League filed a petition for stay of the effective date of the rule changes, citing the possibility of irreparable harm if the rules were to take effect before the Commission had an opportunity to consider the eight petitions for reconsideration. Therefore, by action of the Commission the effective date of the regulations adopted in the report and order in Docket 21033 was stayed until further order of the Commission.

5. The American Radio Relay League subsequently filed a petition to modify the stay order on November 23, 1977. In the petition it states that it had become clear that the content of the petitions for reconsideration indicated only three areas of controversy, and that the public interest would be served by modifying the stay order so that the noncontroversial changes in the rules can become effective at an early date. On February 9, 1978, the Chief, Safety and Special Radio Services Bureau, acting under delegated authority, waived sections, 97.40, 97.43, 97.88, and 97.126 of the Commission's rules to permit licensed amateurs to operate repeater, auxiliary link, control or remotely controlled stations without prior Commission approval.

The Petitions

6. There were three areas of controversy raised by the petitions for reconsideration: The licensing of repeater stations and "WR" call signs; the expansion of the repeater subbands; and the effect of the rule changes on the operating privileges of the Technician Class license holder.

7. *Repeater licensing.* Five petitioners urged the Commission to reconsider its decision which ended separate licensing for repeater, auxiliary link, and control stations and discontinued the issuance of "WR" call signs for repeater stations. The American Radio Relay League argues that repeater stations, by their nature, must operate on fixed frequencies, and that these fixed frequencies must be coordinated. Voluntary frequency coordination has been extremely effective under the present system where an amateur must get a separate repeater license and call sign. The ARRL feels that by removing the requirement of a repeater license it will "substantially decrease the possibility that voluntary cooperation and coordination by amateurs will continue to be effective and practical." The Michigan Area Repeater Council agrees with the ARRL that coordination is important and asserts that the Commission's contention in its report and order in Docket 21033 that "fly-by-night" operations will not occur because of the expense and planning involved in setting up a repeater station is "unfortunate and mistaken." "Very inexpensive repeaters could be built out of junk-box parts * * * a transmitter and receiver strip * * * and a moderate dose of that infamous Amateur home-brew ingenuity." The Michigan Area Repeater Council is concerned that without the identifying factor of a license or a "WR" call sign, the amateur community's capability of self-enforcement will be impaired.

8. Similar fears of disorderly use of the frequencies by amateurs are expressed by petitioners Laurent Blouin, Robert Bingham, and Joseph Reisart, Jr. All three point to the increased risk of interference from unlicensed repeater operation.

9. The ARRL also asserts that ending "WR" call signs for currently licensed repeater stations was not within the scope of our original proposal. It cites the notice of proposed rulemaking in which we said, "We propose to discontinue our policy of assigning call signs prefixed with the letters "WR". Stations presently assigned such call signs would be permitted to retain them indefinitely. A licensee wishing to engage in repeater operation and wishing to obtain a "WR" call sign would be required to request the prefix." In the final draft of the rules, the Commission stated that those holding "WR" call signs would not be able to renew them, nor could anyone get one on request. The ARRL petition states that this action was contrary to the Administrative Procedure Act by failing to give notice to the public that "WR" call signs would be discontinued entirely.

10. *Repeater subbands.* Five petitioners requested reconsideration of the Commission's expansion of the repeater subbands. The major thrust of the arguments was that allowing repeater operation on all amateur frequencies above 220 MHz would significantly interfere with a number of amateur activities in the VHF and UHF bands. According to petitioner Joseph Reisert, Jr., the amateur frequencies 144 through 450 MHz are all used for weak signal reception, experimental communications systems, EME (Earth Moon Earth, or moon bounce) communications, tropospheric propagation and state-of-the-art equipment design. All these activities, he says are examples of amateurs contributing "to the advancement of the radio art," one of the bases and purposes of amateur radio as stated in section 97.1(b). Petitioner Paul Wade adds that "the weak-signal communications are obviously subject to interference by strong signals; the capability of a well-located repeater to unwittingly disturb weak-signal communications at distances far removed from its normal service area illustrates the incompatibility of the two modes." Laurent Blouin states that it is impossible to do "any serious work on weak signal detection if high power FM operations were within 1 MHz of the serious operator."

11. The ARRL, Laurent Blouin, Joseph Reisert, Jr., and Paul Wade mentioned specific subbands they would like to see protected. All four argued that 220.0 to 220.5 MHz, and 431-433 MHz should be set aside (432 MHz is the frequency currently being used for satellite and moon bounce communications), and protected from repeater operation. The ARRL, Joseph Reisert, Jr., and Laurent Blouin also want protection for 222.0 to 222.5 MHz. Paul Wade and the ARRL want 1290 to 1300 MHz protected for future amateur satellite use.[1]

12. The ARRL further argues that when the Commission added 144.5 to 145.5 as a repeater subband, it had done so without adequate notice to the public. The ARRL states that because the notice of proposed rulemaking invited comments only on the proposal to make all frequencies allocated to the Amateur Radio Service except 435 to 438 MHz available for repeater and auxiliary operation, alternatives, such as additional subbands, could not be considered.

13. *Technician class privileges.* Four petitioners are concerned with how the expansion of the repeater subbands to include 144.5 to 145.5 MHz will affect Technician Class operators. Traditionally, 145 MHz has been used by Technician Class operators for single sideband (SSB) and telegraphy operation. Joseph Reisert, Jr. states that the report and order in Docket 21033 "actually takes away rather than gives the technicians any extra privileges since the present c.w. area of 145 to 145.3 MHz will now be open to repeaters and FM." The Chicago FM Club states that "repeater councils across the country are working on a band plan that would provide 'protected' space on a voluntary basis from 144.9-145.1 MHz for SSB/CW operation. But the voluntary plan has some limitations." They go on to state that the only effective solution would be to allow Technician Class operators to operate from 144.2-148.0 MHz.

14. The San Antonio Repeater Organization (SARO) argues that FM repeater use of 144.5 to 145.5 MHz "displaces established SSB use by Technicians without providing new spectrum where they may relocate along with higher class licensees." SARO would extend radiotelephone privileges for Technician Class operators downward to 144.1 MHz. Laurent Blouin argues that if Technician Class operators must share 144.5 to 145.5 MHz with FM repeater operation, there would be no incentive for the holder of the Technician Class license to upgrade. He would allow Technician Class operators telegraphy privileges from 144.0-148.0 MHz and radio telephony privileges from 144.2 to 148.0 MHz.

15. *Comments.* There were 18 comments filed in response to the 8 petitions for reconsideration. Three of the comments opposed the petitions. Fifteen of the comments supported the petitions on at least one of the three issues they raised. The breakdown of support was as follows: Eight commenters were for protection of weak-signal activities, nine commenters wanted to retain separate licensing for repeater stations and "WR" call signs, seven commenters were for added operating privileges for Technician Class license holders. The total adds to more than 15 because many commenters commented on more than one issue.

Discussion

16. *Repeater licensing.* The requirement that amateurs who want to operate a repeater station first obtain a separate repeater license from the Commission was imposed originally in 1972 in Docket 18803. 37 FCC 2d 225 (1972). Before 1972, repeaters were not specifically mentioned in the amateur rules. Amateurs who operated repeaters before 1972 did so under the general guidance of the rules which applied to amateur operation and without a separate repeater license. The Commission, in Docket 18803, sought to emphasize that repeater operation required special rules. To ensure that these new rules were adhered to, the Commission required a separate license based on a substantial showing by the amateur applicant. The information required by the Commission from an applicant included a system network diagram, antenna radiation patterns, certain calculations for effective radiated power and height above average terrain, and technical data relating to remotely controlled stations, control stations, and auxiliary link stations. The requirements for these showings were intended "to verify that the applicant has given careful consideration to the planning and design of his repeater station, addressing particular attention to the geographical area to be covered." 37 FCC 2d 225, 228 (1972).

17. In a long line of rulemaking proceedings beginning in 1974, the extensive showings required by the Commission and several of the more restrictive rules governing repeater operation were gradually dropped. For example, in an Order adopted January 10, 1974, we deleted the requirement that the applicant supply the Commission with his calculations of the effective radiated power and antenna height above average terrain of his proposed station. In Docket 20073, adopted May 28, 1975, the Commission permitted the linking of amateur repeater stations. In Docket 20112, adopted June 11, 1975, the Commission authorized the automatic control of repeater stations under certain conditions. In Docket 20113, adopted October 29, 1975, the Commission permitted crossband oper-

[1] Neither 432 MHz nor 1290 MHz-1300 MHz is available to the Amateur satellite Service.

ation of repeater stations. In addition, by Order of the Commission on November 17, 1975, we removed the requirement that the repeater applicant file certain technical data relating to remotely controlled stations, control stations, and auxiliary link stations, and we allowed portable/mobile operation of remotely controlled stations.

18. This policy of deregulation has brought us to the point where, at present, an applicant for a repeater station need show no more than he is an amateur, and holds at least a Technician Class license. This tremendous shift in regulatory policy has been based on conditions in amateur radio as the Commission has perceived them. Before 1972, the privilege of operating through a repeater was abused by some amateurs, partially out of an unfamiliarity with what new ground rules should apply to this type of operation. Gradually, as conditions stabilized, and as the amateurs learned more about self-regulation and local frequency selection, the Commission deregulated by relieving rule restrictions, and simplifying application procedures. The cooperation amateurs have shown in the use of the amateur frequencies was recognized by the ARRL in comments it filed to the Notice of Proposed Rule Making in this proceeding. In respose to our proposal to establish principles of priority of use of amateur frequencies, it argued that the number of troublesome situations in amateur radio were infinitesimal. The ARRL went on to say that all but a few of the "disagreements over repeater frequencies have been effectively resolved by voluntary frequency coordination." Comments, ARRL at 30.

19. In Docket 21033 we proposed to take the next logical step and end the requirement for a separate license for repeaters. This was done in recognition that the original function of repeater licensing, namely, the stabilization of a new situation, had been served. However, the petitioners in this docket argue that a repeater license is still necessary and still serves a function. The expressed fear is that the situation will become chaotic if any amateur, Technician Class or above, can set up a repeater. However, the state of affairs at present is that any amateur, Technician Class or above, can set up a repeater simply by checking off the appropriate box on the Form 610 and waiting for a repeater license. There is simply no longer any practical purpose served by the licensing process. We should also note that some amateurs have also expressed the fear that, without separate repeater licenses, amateurs who operate their primary stations as repeaters might place their primary station licenses in jeopardy for rule violations committed by users of the repeater. In this regard, the Commission intends to treat the repeater users as being primarily liable for operational rule violations, and will look to the repeater licensee only to the extent that he fails to meet his obligation to provide adequate control of his repeater. As a practical matter, our enforcement efforts in the past have proceeded on this basis. In many instances, we have worked with repeater licensees in tracking down users who commit rule violations through repeaters.

20. To do away with repeater licensing is to do more than relieve the amateur of an exercise he has shown he can do without. It also means the Commission will be able to allocate its resources more efficiently and process other applications in a timely manner. When the Commission announced its freeze on new repeater applications in September, 1977, the Commission had over 9,000 unprocessed repeater license applications on hand. Each application would have required special processing apart from the normal handling given an amateur application, and represented a sizable diversion of Commission manpower from the processing of primary station and operator licenses. Yet, even when the repeater application is finally processed, a large number of these new repeater licenses go unused. We estimate that some 1,500 of the repeater licenses granted by the Commission in the past 5 years were for stations that were never built. Clearly, this amounts to a waste of valuable manpower which could be used much more profitably in other areas.

21. However, the ARRL and others argue that regardless of whether licensing serves a practical function, it does serve a psychological function in that it makes the amateur aware that he is responsible for the proper operation of his repeater. We believe, though, that an amateur is psychologically aware of his responsibilities when he becomes an amateur, and it is not necessary for the Commission to remind the amateur of his responsibilities each time he enters a new field of operation. Would this type of psychological reminder be necessary for sending radio teleprinter signals? slow-scan television signals? or communicating through the amateur satellites?

22. We are therefore affirming the decision made by the Commission in the First Report and Order in Docket 21033 to end the requirement of a separate license for repeater, auxiliary link and control stations.

23. *"WR" call signs.* We agree with the ARRL's contention that adequate notice was not given in the Notice of Proposed Rule Making in Docket 21033 that "WR" call signs for repeaters stations might be discontinued. That proposal was made in Docket 21135, not Docket 21033. The Commission today is adopting a Second Report and Order in Docket 21135 specifically on the issue of "WR" call signs, which deletes the availability of "WR" call signs for repeater operation. For a discussion of that issue, the reader is referred to the Second Report and Order in Docket 21135. The station identification rules adopted in the First Report and Order in Docket 21033 in lieu of "WR" call signs have been modified in response to the petition filed by the Chicago FM Club. The rules, as orginally adopted, required that a station, when identifying by telegraphy, transmit the amateur's call sign followed by "RPT" if in repeater operation, or "AUX" if in auxiliary operation. The Chicago FM Club argues that this method of station identification "constitutes an excessive number of characters" and that the "majority of repeater identification devices lack the capacity to add the characters "RPT" without extensive rebuilding." We agree with the Chicago FM Club. The new rules will give amateurs a choice. They may add either the suffix "R" or the suffix "RPT" when identifying a repeater operation by telegraphy. Similarly, amateurs will be given the choice of "A" or "AUX" when identifying an auxiliary operation.

24. In addition, in response to requests from two petitioners, the Chicago FM Club and the Michigan Area Repeater Council, we are making clear exactly when the repeater identifier is to be used. If an amateur is operating a repeater under the remaining term of his repeater license, he may identify his station either under his "WR" call sign, or he may identify under his primary station call sign followed by the repeater identifier ("R" or "RPT", if telegraphy, "repeater", if telephony). There is no requirement to add the repeater identifier to a "WR" call sign. Of course, amateurs operating new repeaters must use the new repeater identification, because "WR" call signs are no longer available.

25. *Repeater subbands.* Before the question of repeater subbands can be resolved, there is the issue of notice raised by the ARRL: did the Commission give adequate notice to the public that new repeater subbands might be created when it proposed to make all amateur frequencies available to repeater operation? The Administrative Procedure Act requires that the notice of the proposed rule include, "either the terms or substance of the proposed rule, or a description of the subject and issued involved." 5 U.S.C. 553(b)(3). In the Notice of Proposed Rulemaking in this proceeding, the Commission proposed to make all amateur frequency bands, except 435-438 MHz, available for repeater operation. The comments which the Commission received indicated that problems existed with the proposed rule because it would create the danger of incompatibility with other amateur activities. Accordingly, the Commission, in its First Report and Order in Docket 21033, adopted a partial expansion of the repeater subbands, limiting it to amateur frequencies above 220 MHz and adding a one megahertz repeater subband in the two meter band, 144.5-145.5 MHz.

26. The ARRL argues that the creation of a one megahertz repeater subband at 144.5-145.5 MHz was not proposed originally. It contends that rules setting aside repeater subbands can not be adopted when the public is only given notice that the Commission is considering making all amateur frequencies available to repeaters. Yet, it is well established that "a notice of rulemaking is sufficient if it provides a description of the subjects and issues involved." *California Citizens Band Ass'n* v. *United States*, 375 F. 2d 43, 49, certiorari denied, 389 U.S. 844 (1967). See also, *Mt. Mansfield Television, Inc.* v. *FCC*, 442 F. 2d 470 (1971), and *Buckeye Cablevision, Inc.* v. *FCC*, 128 U.S. App. D.C. 262, 387 F. 2d 220 (1967). Further, the Administrative Procedure Act "does not require an agency to publish in advance every precise proposal which it may ultimately adopt as a rule." *California Citizens Band Ass'n*, supra, at 48. The position taken by the ARRL denies the purpose of a rulemaking proceeding—to allow an agency the flexibility it needs to shape the final rule on the basis of the comments it receives. The Administrative Procedure Act does not require an agency to either adopt or reject a proposal in total. This would be too rigid a restriction on the capability of an agency to act. The public comments indicated that in the two meter band, 144.0-144.5 MHz and 145.5-146.0 MHz were not appropriate for repeater activity, and therefore we declined to make those frequency ranges available to repeater operation. It seems clear that the public was on notice as to our proposed actions, and wanted us to consider alternative solutions, short of a total expansion of the repeater bands. We therefore find that proper notice was given the public on the issue of repeater subbands.

27. We turn now to the arguments of the petitioners on repeater subbands. In our First Report and Order in Docket 21033, we stated that we believed that weak signal work and other amateur activities should be afforded protection from repeater transmissions, and accordingly set out the 144.0-144.5 and 145.5-146.0 MHz ranges as ranges which would not be available to repeater operation. It has become apparent from the several Petitions for Reconsideration that we should set aside additional frequency ranges that would be free from repeater operation. We will therefore not allow repeater or auxiliary operation in the 220.0-220.5 MHz and 431-433 MHz ranges. According to the petitioners, these subbands contain the bulk of the experimentation with moon bounce and satellite transmissions being carried out today.

28. At the same time, we do not feel that the other two subbands mentioned by the petitioners require protection. 222.0-222.5 MHz was a part of the original repeater subband of 222-225 MHz when repeater subbands were established in 1972, and we can see no reason to afford it any protection now. 1290-1300 MHz was cited by two petitioners as requiring protection for future satellite activity. To the best of our knowledge, there are no repeaters in the United States in that band, nor is there any satellite activity. We would prefer, given these circumstances, to await future development of the band by amateurs, fully expectant that the band is wide enough to accommodate many amateur activities.[2]

29. *Technician Class privileges.* The Commission has proposed in Docket 20282 to give Technician Class operators full privileges in the two meter band, 144-148 MHz. This would, in effect, give to Technician Class amateurs the privileges sought by the petitioners in this docket. Therefore, the Commission today is adopting a Second Report and Order in Docket 20282 granting, among other things, full privileges to Technician Class operators in the 144-148 MHz band.

30. Accordingly, in view of the foregoing: *It is ordered*, That the Petitions for Reconsideration of the Commission's action in Docket 21033 submitted by the American Radio Relay League, Robert Bingham, Laurent J. Blouin, the Chicago FM Club, the Michigan Area Repeater Council, Joseph H. Reisert, Jr., the San Antonio Repeater Organization, and Paul Wade are granted to the extent indicated in paragraphs 23, 27, and 29, supra, and are otherwise denied. *It is further ordered*, That the Petition to Modify the Stay Order filed by the American Radio Relay League is dismissed as moot. *It is further ordered*, That pursuant to authority contained in Sections 4(i) and 303 of the Communications Act of 1934, as amended, Part 97 of the Commission's Rules IS AMENDED as set forth in the attached Appendix, effective May 15, 1978. *It is further ordered*, That the Stay Order in Docket 21033, adopted November 4, 1977, and the "freeze" announced in that Stay Order on the filing of applications for new repeater, auxiliary link and control station licenses are continued until the effective date of these regulations.

(Secs. 4, 303, 307, 48 Stat., as amended, 1066, 1082, 1083; 47 U.S.C. 154, 303, 307.)

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

Part 97 of Chapter 1 of Title 47 of the Code of Federal Regulations is amended, as follows:

1. In § 97.3, paragraph (i) is deleted, paragraphs (j), (k), and (l) are redesignated (i), (j), and (k), respectively, paragraph (m) is redesignated paragraph (l) and in that paragraph, the definition of amateur radio operation is amended, and new definitions of repeater operation and auxiliary operation are added, paragraph (n) is redesignated paragraph (m) and in that paragraph, the definitions of control and automatic control are amended, and paragraphs (o), (p), (q), (r), (s), (t), (u), (v), (w), (x), (y), (z), and (aa), are redesignated (o), (p), (q), (r), (s), (t), (u), (v), (w), (x), (y), and (z) respectively.

§ 97.3 Definitions.

* * * * *

(l) *Amateur radio operation.* Amateur radio communication conducted by amateur radio operators from amateur radio stations, including the following:

* * * * *

Mobile operation. Radiocommunication conducted while in motion or during halts at unspecified locations.

Repeater operations. Radiocommunication, other than auxiliary operation, for retransmitting automatically the radio signals of other amateur radio stations.

Auxiliary operations. Radiocommunication for remotely controlling other amateur radio stations, for automatically relaying the radio signals of other amateur radio stations in a system of stations, or for intercommunicating with other amateur radio stations in a system of amateur radio stations.

(m) *Control* means techniques used for accomplishing the immediate operation of an amateur radio station. Control includes one or more of the following:

* * * * *

(3) *Automatic control* means the use of devices and procedures for control so that the control operator does not have to be present at the control point at all times. (Only rules for automatic control of stations in repeater operation have been adopted.

* * * * *

§ 97.40 [Amended]

2. In § 97.40, paragraphs, (c), (d), and (e), are deleted.

§ 97.41 [Amended]

3. In § 97.41, paragraphs (b) and (c) are deleted, and paragraph (d) and and (e) are redesignated paragraphs (b) and (c) respectively.

4. § 97.43 is revised to read, as follows:

§ 97.43 Location of station.

Every amateur radio station shall

[2] See n. 1, supra at 4.

have one land location, the address of which appears in the station license, and at least one control point.

5. In § 97.61, paragraphs (a) and (c) are revised and a new paragraph (d) is added, as follows:

§ 97.61 Authorized frequencies and emissions.

(a) The following frequency bands and associated emission are available to amateur radio stations for amateur radio operation, other than repeater and auxiliary operation, subject to the limitations of Section 97.65 and paragraph (b) of this section. * * *

* * * * *

(c) All amateur frequency bands above 29.5 MHz are available for repeater operation, except 50.0–52.0 MHz, 144.0–144.5 MHz, 145.5–146.0 MHz, 220.0–220.5 MHz, 431.0–433.0 MHz, and 435.0–438.0 MHz. Both the input (receiving) and output (transmitting) frequencies of a station in repeater operation shall be frequencies available for repeater operation.

(d) All amateur frequency bands above 220.5 MHz, except 431–433 MHz, and 435–438 MHz, are available for auxiliary operation.

6. In § 97.63, the headnote is revised and the text amended, as follows:

§ 97.63 Selection and use of frequencies.

(a) An amateur station may transmit on any frequency within any authorized amateur frequency band.

(b) Sideband frequencies resulting from keying or modulating a carrier wave shall be confined within the authorized amateur band.

(c) The frequencies available for use by a control operator of an amateur station are dependent on the operator license classification of the control operator and are listed in § 97.7.

7. In § 97.67, paragraph (c) is revised to read, as follows:

§ 97.67 Maximum authorized power.

* * * * *

(c) Within the limitations of paragraphs (a) and (b) of this section, the effective radiated power of an amateur radio station in repeater operation shall not exceed the power specified for the antenna height above average terrain in the following table:

Antenna height above average terrain	Maximum effective radiated power for frequency bands above			
	52 MHz	144.5 MHz	420 MHz	1215 MHz
	Watts	Watts		
Below 50 ft	100	800	Paragraphs (a) and (b).	Paragraphs (a) and (b).
50–99 ft	100	400	....do	Do.
100–499 ft	50	400	800 W	Do.
500–999 ft	25	200	....do	Do.
Above 1,000 ft	25	100	400 W	Do.

8. § 97.83 is redesignated § 97.82, as follows:

§ 97.82 Availability of operator license.

* * * * *

9. § 97.85 is redesignated § 97.83, as follows:

§ 97.83 Availability of station license.

* * * * *

10. § 97.87 is redesignated § 97.84, and paragraphs (c), (d), and (e) are revised, as follows:

§ 97.84 Station identification.

* * * * *

(c) An amateur radio station in repeater operation or a station in auxiliary operation used to relay automatically the signals of other stations in a system of stations shall be identified by radiotelephony or radiotelegraphy at a level of modulation sufficient to be intelligible through the repeated transmission at intervals not to exceed ten minutes.

(d) When an amateur radio station is in repeater or auxiliary operation, the following additional identifying information shall be transmitted:

(1) When identifying by radiotelephony, a station in repeater operation shall transmit the word "repeater" at the end of the station call sign. When identifying by radiotelegraphy, a station in repeater operation shall transmit the fraction bar DN followed by the letters "RPT" or "R" at the end of the station call sign. (The requirements of this subparagraph do not apply to stations having call signs prefixed by the letters "WR".)

(2) When identifying by radiotelephony, a station in auxiliary operation shall transmit the word "auxiliary" at the end of the station call sign. When identifying by radiotelegraphy, a station in auxiliary operation shall transmit the fraction bar DN followed by the letters "AUX" or "A" at the end of the station call sign.

(e) A station in auxiliary operation may be identified by the call sign of its associated station.

* * * * *

11. A new § 97.85 is added, as follows:

§ 97.85 Repeater operation.

(a) Emissions from a station in repeater operation shall be discontinued within five seconds after cessation of radiocommunications by the user station. Provisions to limit automatically the access to a station in repeater operation may be incorporated but are not mandatory.

(b) Except for operation under automatic control, as provided in paragraph (c) of this section, the transmitting and receiving frequencies used by a station in repeater operation shall be continuously monitored by a control operator immediately before and during periods of operation.

(c) A station in repeater operation shall not concurrently retransmit amateur radio signals on more than one frequency in the same amateur frequency band, from the same location.

(d) A station in repeater operation shall be operated in a manner ensuring that it is not used for one-way communications, except as provided in § 97.91.

(e) A station in repeater operation, either locally controlled or remotely controlled, may also be operated by automatic control when devices have been installed and procedures have been implemented to ensure compliance with the rules when a duty control operator is not present at a control point of the station. Upon notification by the Commission of improper operation of a station under automatic control, operation under automatic control shall be immediately discontinued until all deficiencies have been corrected.

12. A new § 97.86 is added, as follows:

§ 97.86 Auxiliary operation.

(a) A station in auxiliary operation, either locally controlled or remotely controlled, may also be operated by automatic control when it is operated as part of a system of stations in repeater operation operated under automatic control.

(b) If a station in auxiliary operation is relaying signals of another amateur radio station(s) to a station in repeater operation, the station in auxiliary operation may use an input (receiving) frequency in frequency bands reserved for auxiliary operation, repeater operation, or both.

(c) A station in auxiliary operation shall be used only to communicate with stations shown in the system network diagram.

13. In Section 97.88, the headnote, introductory paragraph, paragraphs (a), (b), (c), and (e) are amended to read as follows:

§ 97.88 Operation of a station by remote control.

An amateur radio station may be operated by remote control only if there is compliance with the following:

(a) A photocopy of the remotely controlled station license shall be—

(1) Posted in a conspicuous place at the remotely controlled transmitter location, and

(2) Placed in the station log of each authorized control operator.

(b) The name, address, and telephone number of the remotely controlled station licensee and at least one control operator shall be posted in a conspicuous place at the remotely controlled transmitter location.

(c) Except for operation under automatic control, a control operator shall be on duty when the station is being remotely controlled. Immediately before and during the periods the remotely controlled station is in operation, the frequencies used for emission by the remotely controlled station shall be monitored by the control operator. The control operator shall terminate all transmissions upon any deviation from the rules.

* * * * *

(e) A station in repeater operation shall be operated by radio remote control only when the control link uses frequencies other than the input (receiving) frequencies of the station in repeater operation.

§ 97.89 [Amended].

14. In § 97.89, paragraphs (c) and (d) are deleted.

15. Section 97.95(a)(1) is revised to read, as follows:

§ 97.95 Operation away from the authorized fixed station location.

(a) * * *

(1) When there is no change in the authorized fixed operation station location, an amateur radio station, other than a military recreation station, may be operated portable or mobile under its station license anywhere in the United States, its territories or possessions, subject to Section 97.61.

* * * * *

16. In Section 97.103, paragraph (c)(5) is deleted, paragraphs (c), (c)(1), (c)(2), (c)(3), (c)(4), (d), (e), (e)(1), (e)(2), (e)(3), (e)(4), (e)(5) are amended, and (e)(6) and (e)(7) are added; paragraph (f) as amended, is redesignated as paragraph (g), and a new paragraph (f) is added to read as follows:

§ 97.103 Station log requirements.

* * * * *

(c) In addition to the other information required by this section, the log of a remotely controlled station shall have entered the names, addresses, and call signs of all authorized control operators and a functional block diagram of, and a technical explanation sufficient to describe the operation of the control link. Additionally, the following information shall be entered:

(1) A description of the measures taken for protection against access to the remotely controlled station by unauthorized persons;

(2) A description of the measures taken for protection against unauthorized station operation, either through activation of the central link, or otherwise;

(3) A description of the provisions for shutting down the station in the case of control link malfunction; and

(4) A description of the means used for monitoring the transmitting frequencies.

(d) When a station has one or more associated stations, that is, stations in repeater or auxiliary operation, a system network diagram shall be entered in the station log.

(e) In addition to the other information required by this section, the log of a station in repeater operation transmitting with an effective radiated power greater than the minimum effective radiated power listed in § 97.67(c) for the frequency band in use shall contain the following:

(1) The location of the station transmitting antenna, marked upon a topographic map having a scale of 1:250,000 and contour intervals[1];

(2) The antenna transmitting height above average terrain[2];

(3) The effective radiated power in the horizontal plane for the main lobe of the antenna pattern, calculated for maximum transmitter output power;

(4) The transmitter output power;

(5) The loss in the transmission line between the transmitter and the antenna, expressed in decibels;

(6) The relative gain in the horizontal plane of the transmitting antenna; and

(7) The horizontal and vertical radiation patterns of the transmitting antenna, with reference to true north (for horizontal pattern only), expressed as relative field strength (voltage) or in decibels, drawn upon polar coordinate graph paper, and the method used in determining these patterns.

(f) In addition to the other information required by this section, the log of a station in auxiliary operation shall have the following information entered:

(1) A system network diagram for each system with which the station is associated;

(2) The station transmitting band(s);

(3) The transmitter input power; and

(4) If operated by remote control, the information required by paragraph (c) of this section.

(g) Notwithstanding the provisions of § 97.105, the log entries required by paragraphs (c), (d), (e), and (f) of this section shall be retained in the station log as long as the information contained in those entries is accurate.

§ 97.109 [Deleted]

17. § 97.109 is deleted.

§ 97.110 [Deleted]

18. § 97.110 is deleted.

§ 97.111 [Deleted]

19. § 97.111 is deleted.

20. § 97.126 is revised to read, as follows:

§ 97.126 Retransmitting radio signals.

(a) An amateur radio station, except a station in repeater operation or auxiliary operation, shall not automatically retransmit the radio signals of other amateur radio stations.

(b) A remotely controlled station, other than a remotely controlled station in repeater operation or auxiliary operation, shall automatically retransmit only the radio signals of stations in auxiliary operation shown on the remotely controlled station's system network diagram.

21. § 97.181(b) is amended to read as follows:

§ 97.181 Availability of RACES station license and operator licenses.

* * * * *

(b) In addition to the operator license availability requirements of § 97.82, a photocopy of the control operator's amateur radio operator license shall be posted in a conspicuous place at the control point of the RACES station.

AMATEUR RADIO SERVICE

Amateur Station Call Sign Assignment System

MARCH 30, 1978.

Effective March 24, 1978, section 97.51 of the Amateur Radio Service regulations requires amateur station call signs to be issued systematically, with details of the system to be made public. The following system will be effective until further notice.

WHICH PAST POLICIES AND RULES HAVE BEEN ELIMINATED?

(a) All prior call sign policies and procedures, written or unwritten, are cancelled and are hereby replaced.

(b) No requests for specific call signs will be honored.

WHAT WILL HAPPEN TO EXISTING STATIONS?

[1]Indexes and ordering information for suitable maps are available from the U.S. Geologic Survey, Washington, D.C. 20242, or from the Federal Center, Denver, Colo. 80225.

[2]See Appendix 5.

(c) All amateurs may continue to hold their existing primary station call signs unless they request a change, even if they are moving to new call sign areas.

(d) Section 97.40 of the Commission's Rules permits only one primary station per operator. Although this is not a new limitation, licensees may have received more than one primary call sign due to processing erros. Any such licensees must choose one of the primary call signs for their sole primary station, and submit the other license for cancellation by October 1, 1978.

(e) No new secondary or special event station licenses will be issued. Existing licenses will not be renewed or modified, but may continue to operate until their expiration dates. We will permit a holder to transfer an existing secondary station call sign to the primary station anytime prior to expiration. The secondary station license will be cancelled at that time.

How Will Future Call Signs Be Assigned?

(f) (1) Initial assignment of call sign digits will conform to Table A in the contiguous 48 states and the District of Columbia:

Table A

Digit:	*Location*
1	Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.
2	New York, New Jersey.
3	Pennsylvania, Delaware, Maryland, District of Columbia.
4	Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Kentucky.
5	Mississippi, Louisiana, Arkansas, Oklahoma, Texas, New Mexico.
6	California.
7	Oregon, Washington, Idaho, Montana, Wyoming, Arizona, Nevada, Utah.
8	Michigan, Ohio, West Virginia.
9	Illinois, Indiana, Wisconsin.
10	Colorado, Nebraska, North Dakota, South Dakota, Minnesota, Iowa, Missouri.

(2) Initial assignment of call sign prefixes will conform to Table B outside the contiguous 48 states:

Table B

Prefix	*Location*
AH1, KH1, NH1, WH1	Baker, Canton, Enderbury, Howland Islands.
AH2, KH2, NH2, WH2	Guam.
AH3, KH3, NH3, WH3	Johnston Island.
AH4, KH4, NH4, WH4	Midway Island.
AH5K, KH5K, NH5K, WH5K	Kingman Reef.
AH5, KH5, NH5, WH5	(Except K suffix) Palmyra, Jarvis Islands.
AH6, KH6, NH6, WH6	Hawaii.
AH7, KH7, NH7, WH7	Kure Island.
AH8, KH8, NH8, WH8	American Samoa.
AH9, KH9, NH9, WH9	Wake, Wilkes, Peale Islands.
AL7, KL7, NL7, WL7	Alaska.
KP1, NP1, WP1	Navassa Island.
KP2, NP2, WP2	Virgin Island.
KP3, NP3, WP3	Navador Key, Quita Sueno Bank, Serrana Bank, Serranilla Bank.
KP4, NP4, WP4	Puerto Rico.

The digit or prefix from the Tables will be determined by the location of the licensee's bona fide mailing address. When the mailing address is modified, the station will automatically retain the current call sign even if the new address no longer conforms to the digit or prefix for that location. However, a licensee may request a new systematically assigned call sign conforming to the Tables. Counterpart call signs will not be issued.

Although some call sign prefixes in Table B may not be assigned for lack of a bona fide mailing address, the entries are provided for future reference, and to enable amateurs to have a distinct identifier when operating a portable station from these locations.

What Types of Call Signs Will Be Available?

(g) Amateur call sign blocks will be categorized into five major groups.

For the contiguous United States:

(1) Group A contains all 1 x 2, most 2 x 1, and most "A" prefixed 2 x 2 call signs;

(2) Group B contains most "K", "N", and "W" prefixed 2 x 2 call signs;

(3) Group C contains all 1 x 3 call signs;

(4) Group D contains most "K" and "W" prefixed 2 x 3 call signs; and

(5) Group X contains "WC", "WK", "WM", "WR", and "WT" prefixed 2 x 3 call signs.

For the noncontinguous United States:

(1) Group A contains "AH", "KH", "NH", "WH", "AL7", "KL7", "NL7", "KP", "NP", and "WP" prefixed 2 x 1 call signs;

(2) Group B contains "AH", "AL7", and "KP" prefixed 2 x 2 call signs;

(3) Group C contains "KH", "NH", "WH", "KL7", "NL7", "WL7", "NP", and "WP" prefixed 2 x 2 call signs;

(4) Group D contains "KH", "WH", "KL7", "WL7", "KP", and "WP" prefixed 2 x 3 call signs; and

(5) Group X contains "WC", "WK", "WM", "WR", and "WT" prefixed 2 x 3 call signs.

(See Appendix attached to this release which lists all Groups and the call sign blocks which are contained within each Group.)

Who Is Eligible to Request a New Call Sign March 24?

(h) To apportion workload to a manageable level and to gain experience in implementing the new system, we will accept requests for call sign changes only from the following four groups:

(1) Newly licensed operators;

(2) Amateur Extra Class licensees;

(3) Licensees who upgrade their operator privileges; and

(4) Licensees who change their mailing addresses to new call sign areas.

In future phases, we anticipate permitting Advanced Class licensees to request Group B or Group C call signs, and General and Technician Class, Group C call signs.

What About Amateur Extra Class Licensees?

(i) Amateur Extra Class licensees holding Group B call signs may request Group A call signs; Amateur Extra Class licensees holding Group C call signs may request Group B or Group A call signs; and Amateur Extra Class licensees holding Group D call signs may request Group C, Group B, or Group A call signs.

(j) Amateur Extra Class licensees who now hold Group A 2 x 2 call signs beginning with "AA" may request a change within Group A. Such requests must be submitted by October 1, 1978. A 2 x 1 call sign will be issued in exchange for the 2 x 2 "AA" call sign.

What About Licensees Who Upgrade?

(k) A licensee who upgrades his license to a higher operator class may request a new call sign according to the following. If no request is made, his station will retain its present call sign.

(1) Upgrades to Amateur Extra:

(a) Now holding Group B may request Group A;

(b) Now holding Group C may request Group A, or Group B; and

(c) Now holding Group D may request Group A, or Group B; or Group C.

(2) Upgrades to Advanced:

(a) Now holding Group C may request Group B; and

(b) Now holding Group D may request Group C or Group B.

(3) Upgrades to General and Technician Class now holding Group D may request Group C.

What About Newly Licensed Operators?

(1) Newly licensed operators who do not presently have a station call sign will have no choice of format. Their stations will automatically be assigned call signs per Table C.

Table C

(1) Amateur Extra Class operators receive Group A call signs;

(2) Advanced Class operators receive Group B call signs;

(3) General Class operators receive Group C call signs;

(4) Technician Class operators receive Group C call signs; and

(5) Novice Class operators receive Group D call signs;

What About A Licensee Moving to a New Call Sign Area?

(m) A licensee who changes his permanent mailing address to a new call sign area may request a call sign change. In these cases, a station will be assigned a call sign from the same Group (A, B, C, or D) as the call sign now held. The only exceptions are the following:

(1) Advanced Class operators holding Group A may request only Group B; and

(2) General or Technician Class operators holding Group A or Group B may request only Group C.

What About Licensees Who Renew?

(n) Upon renewal, the station will retain the same call sign, unless the li-

GROUP A

AMATEUR RADIO SERVICE—CALL SIGN ASSIGNMENT ORDER

Block No.	CONTIGUOUS USA	PACIFIC AREA	ALASKA AREA	ATLANTIC AREA
1.	K # ##	AH # #	AL 7 #	KP # #
2.	N # ##	KH # #	KL 7 #	NP # #
3.	W # ##	NH # #	NL 7 #	WP # #
4.	AA # #	WH # #	WL 7 #	GROUP B
5.	AB # #	GROUP B	GROUP B	
6.	AC # #			
7.	AD # #			
8.	AE # #			
9.	AF # #			
10.	AG # #			
11.	AI # #			
12.	AJ # #			
13.	AK # #			
14.	KA # #			
15.	KB # #			
16.	KC # #			
17.	KD # #			
18.	KE # #			
19.	KF # #			
20.	KG # #			
21.	KI # #			
22.	KJ # #			
23.	KK # #			
24.	KM # #			
25.	KN # #			
26.	KO # #			
27.	KQ # #			
28.	KR # #			
29.	KS # #			
30.	KT # #			
31.	KU # #			
32.	KV # #			
33.	KW # #			
34.	KX # #			
35.	KY # #			
36.	KZ # #			
37.	NA # #			
38.	NB # #			
39.	NC # #			
40.	ND # #			
41.	NE # #			
42.	NF # #			
43.	NG # #			
44.	NI # #			
45.	NJ # #			
46.	NK # #			
47.	NM # #			
48.	NN # #			
49.	NO # #			
50.	NQ # #			

Block No.	CONTIGUOUS USA
51.	NR # #
52.	NS # #
53.	NT # #
54.	NU # #
55.	NW # #
56.	NX # #
57.	NY # #
58.	NZ # #
59.	WA # #
60.	WB # #
61.	WC # #
62.	WD # #
63.	WE # #
64.	WF # #
65.	WG # #
66.	WI # #
67.	WJ # #
68.	WK # #
69.	WM # #
70.	WN # #
71.	WO # #
72.	WQ # #
73.	WR # #
74.	WS # #
75.	WT # #
76.	WU # #
77.	WV # #
78.	WW # #
79.	WX # #
80.	WY # #
81.	WZ # #
82.	AA # ##
83.	AB # ##
84.	AC # ##
85.	AD # ##
86.	AE # ##
87.	AF # ##
88.	AG # ##
89.	AI # ##
90.	AJ # ##
91.	AK # ##
92.	GROUP B
93.	

GROUP B

AMATEUR RADIO SERVICE—CALL SIGN ASSIGNMENT ORDER

Block No.	CONTIGUOUS USA	PACIFIC AREA	ALASKA AREA	ATLANTIC AREA
1.	KA 1 ##	AH # ##	AL 7 ##	KP # ##
2.	KB # ##	GROUP C	GROUP C	GROUP C
3.	KC # ## (EXCEPT KC6)			
4.	KD # ##			
5.	KE # ##			
6.	KF # ##			
7.	KG # ## (EXCEPT KG4, KG6R, KG6S)			
8.	KI # ##			
9.	KJ # ##			
10.	KK # ##			
11.	KM # ##			
12.	KN # ##			
13.	KO # ##			
14.	KQ # ##			
15.	KR # ## (EXCEPT KR6)			
16.	KS # ##			
17.	KT # ##			
18.	KU # ##			
19.	KV # ##			
20.	KW # ##			
21.	KX # ## (EXCEPT KX6)			
22.	KY # ##			
23.	KZ # ## (EXCEPT KZ5)			
24.	NA # ##			
25.	NB # ##			
26.	NC # ##			
27.	ND # ##			
28.	NE # ##			
29.	NF # ##			
30.	NG # ##			
31.	NI # ##			
32.	NJ # ##			
33.	NK # ##			
34.	NM # ##			
35.	NN # ##			
36.	NO # ##			
37.	NQ # ##			
38.	NR # ##			
39.	NS # ##			
40.	NT # ##			
41.	NU # ##			
42.	NW # ##			
43.	NX # ##			
44.	NY # ##			
45.	NZ # ##			
46.	WA # ##			
47.	WB # ##			
48.	WC # ##			
49.	WD # ##			
50.				

Block No.	CONTIGUOUS USA
51.	WE # ##
52.	WF # ##
53.	WG # ##
54.	WI # ##
55.	WJ # ##
56.	WK # ##
57.	WM # ##
58.	WN # ##
59.	WO # ##
60.	WQ # ##
61.	WR # ##
62.	WS # ##
63.	WT # ##
64.	WU # ##
65.	WV # ##
66.	WW # ##
67.	WX # ##
68.	WY # ##
69.	WZ # ##
70	GROUP C

censee qualifies for and requests a call sign change.

WHICH CALL SIGNS WILL BE ASSIGNED?

(o) Call sign assignments will begin as follows:

	Contiguous U.S.	Non-contiguous U.S.
Group:		
A	Block 4	Block 1.
B	Block 1	Do.
C	Block 2	Do.
D	Block 1	Block 2.

(p) Available call sign suffixes will be assigned in alphabetical sequence; for 2x3 and 1x3 call signs, this would involve the sequences AAA, AAB, AAC, and so on, through ZZZ; for 2x2 and 1x2 call signs, the sequences AA through ZZ, for 2x1 call signs, the sequence A through Z

(q) When all assignments have been made from a particular block, the next assignment will be made from the next consecutive block within the group. Periodically, the licensee data base will be scanned to recover the unassigned call signs from prior blocks. These will be added to the lists of call signs available for immediate assignment.

HOW DO AMATEURS APPLY FOR CALL SIGN CHANGES?

(r) Licensees must request a call sign Group for which they are eligible on FCC Form 610, Item 13. The only request which may be made is for a particular Group. No request will be honored for specific call signs, call sign blocks, prefixes, or suffixes within a block. If a group preference is not indicated in Item 13 or the applicant is not eligible for the group he requests, the group will be assigned systematically according to Table C.

(s) When a licensee's permanent station location is changed, a Form 610 must be filed giving the new location. (Station location is no longer used in determining the selection of call sign digits; therefore, a change of station location may not be used as the basis for requesting a change of call sign.)

(t) Applicants requesting exchange of secondary call signs for primary call signs must attach a written request to their Forms 610.

GROUP X.—Amateur radio service—call sign assignment order

	All Areas
Races	WT # ###
Club	WK # ###
Military recreation	WM # ###
Repeaters	WR # ###
Temporary licenses	WT # ###

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

PERMITTING SHIP RADIOTELEGRAPH STATIONS TO COMMUNICATE WITH AMATEUR STATIONS

AGENCY: Federal Communications Commission.

ACTION: Proposed rule making.

SUMMARY: This document proposes the deletion of certain sections of the Commission's rules and regulations relating to the granting of licenses, modification of licenses, renewal of license, or special temporary authorization permitting a ship radiotelegraph station to communicate with amateur stations. These rules no longer serve any useful purpose in the present regulatory scheme, consequently, the Commission is proposing to delete them from the regulations.

DATES: Comments must be received on or before June 12, 1978, and Reply Comments must be received on or before June 22, 1978.

ADDRESSES: Federal Communications Commission, Washington, D.C. 20554.

FOR FURTHER INFORMATION CONTACT:

John C. K. Hays, Safety and Special Radio Services Bureau, 202-632-7197.

SUPPLEMENTARY INFORMATION:

Adopted: April 26, 1978; Released: May 9, 1978. By the Commission:

1. Notice of Proposed Rulemaking in the above-entitled matter is hereby given.

2. Under sections 83.50 and 83.70 of the rules, the Commission may grant a license, modification of license, renewal of license, or special temporary authorization permitting a ship radiotelegraph station on board a vessel not engaged in commerce or a vessel used, or intended to be used, for scientific research or expedition, to transmit by means of Class A1 or A2 emission on authorized ship telegraph frequencies within the band 2000 kHz to 25,000 kHz, for the purpose of exchanging radiotelegraph communications directly with licensed amateur stations on land. This authorization may only be granted upon a showing that: (1) Unusual circumstances make direct communications with amateur stations extremely beneficial to persons on board or to persons responsible for the scientific expedition; (2) messages will not relate to commercial communications; and (3) no harmful inteference will result to stations in the maritime mobile service nor to stations in the radiolocation service.

3. It now appears that these rule sections, which were adopted in 1939, serve no useful purpose under the present regulatory scheme. A review of our license file disclosed that no ship station is presently authorized under these sections to communicate with amateur stations. Moreover, if communications between a vessel and amateur stations is desired, an amateur mobile station, which is a radio installation separate from the ship station, can be operated aboard the vessel provided the operator is a licensed amateur and the requirements of sections 97.101 and 97.114 of the Amateur Rules are observed. We, therefore, are proposing to delete sections 83.50 and 83.70, as shown in the attached Appendix.

4. The proposed amendments to the rules as set forth in the Appendix are issued pursuant to the authority contained in sections 4(i) and 303(r) of the Communications Act of 1934, as amended.

5. Pursuant to applicable procedures set forth in section 1.415 of the Commission's rules, interested persons may file comments on or before June 12, 1978, and reply comments on or before June 22, 1978. All relevant and timely comments and reply comments will be considered by the Commission before final action is taken in this proceeding. In reaching its decision in this proceeding, the Commission may also take into account other relevant information before it, in addition to the specific comments invited by this Notice.

6. In accordance with the provisions of Section 1.419 of the Commission's rules, an original and 5 copies of all statements, briefs or comments filed shall be furnished to the Commission. Responses will be available for public inspection during regular business hours in the Commission's Public Reference Room at its headquarters in Washington, D.C.

FEDERAL COMMUNICATIONS COMMISSION,
WILLIAM J. TRICARICO,
Secretary.

Part 83 of Chapter I of Title 47 of the Code of Federal Regulations is amended as follows:

§ 83.50 [Deleted]

1. Section 83.50 is deleted and designated as [Reserved].

§ 83.70 [Deleted]

2. Section 83.70 is deleted and designated as [Reserved].

GROUP C

AMATEUR RADIO SERVICE—CALL SIGN ASSIGNMENT ORDER

Block No.	CONTIGUOUS USA	PACIFIC AREA	ALASKA AREA	ATLANTIC AREA
1.	K # *ccc*	KH # *cc*	KL 7 *cc*	WP # *cc*
2.	N # *ccc*	NH # *cc*	NL 7 *cc*	WP # *cc*
3.	W # *ccc*	WH # *cc*	WL 7 *cc*	GROUP D
4.	GROUP D	GROUP D	GROUP D	

GROUP D

AMATEUR RADIO SERVICE—CALL SIGN ASSIGNMENT ORDER

Block No.	CONTIGUOUS USA	PACIFIC AREA	ALASKA AREA	ATLANTIC AREA
1.	KA # *ccc*	KH # *ccc*	KL7 *ccc*	KP # *ccc*
2.	KB # *ccc*	WH # *ccc*	WL7 *ccc*	WP # *ccc*
3.	KC # *ccc* (*)			
4.	KD # *ccc*			
5.	KE # *ccc*	*EXCEPT KC4AAA-AAF, KC4USA-USZ		
6.	KF # *ccc*			
7.	KG # *ccc*			
8.	KI # *ccc*			
9.	KJ # *ccc*			
10.	KK # *ccc*			
11.	KM # *ccc*			
12.	KN # *ccc*			
13.	KO # *ccc*			
14.	KQ # *ccc*			
15.	KR # *ccc*			
16.	KS # *ccc*			
17.	KT # *ccc*			
18.	KU # *ccc*			
19.	KV # *ccc*			
20.	KW # *ccc*			
21.	KX # *ccc*			
22.	KY # *ccc*			
23.	KZ # *ccc*			
24.	WA # *ccc*			
25.	WB # *ccc*			
26.	WD # *ccc*			
27.	WE # *ccc*			
28.	WF # *ccc*			
29.	WG # *ccc*			
30.	WI # *ccc*			
31.	WJ # *ccc*			
32.	WN # *ccc*			
33.	WO # *ccc*			
34.	WQ # *ccc*			
35.	WS # *ccc*			
36.	WU # *ccc*			
37.	WV # *ccc*			
38.	WW # *ccc*			
39.	WX # *ccc*			
40.	WY # *ccc*			
41.	WZ # *ccc*			

Ham Help

I need some "Ham Help." Recently, I purchased a Johnson Viking Invader 2000 transmitter in mint condition, but without the manual. Does anyone have a manual for this rig that I could purchase outright? If not, I will pay the owner to make a photostatic copy for me. If a manual or copy of one isn't available, I'd still like to hear from past or present owners of this rig who might be able to give me the proper tune-up alignment procedure, and meter readings during operation.

Rod Robbins WA7IRY
14980 SW 96th
Tigard OR 97223

I have a Knight R-100A general coverage receiver that has a bad main tuning capacitor. The capacitor has (R²C) stamped on the rear, upper left-hand corner. Does anyone know who might have made this capacitor? Does anyone know where I might get parts for Knight radio equipment? I also need a schematic of the R-100A. Any information would help.

Frederick J. Erickson
105 G St.
Turners Falls MA 01376

I need an operating manual and schematic for the Phasemaster IIB transmitter made by Lakeshore Industries in 1959. Hi, Inc., doesn't have it in their catalog of old manuals. I will pay for photocopy and postage.

Frederick John Onucki WA2SKP
63 Highland Ave.
Metuchen NJ 08840

At a recent hamfest, I acquired a large, transistorized six-digit multimeter, Model 882, made by Electro Instruments, which is now out of business. The meter is autoranging and works fine, but I have no schematic or calibration information. If anyone can provide this info, I will be happy to pay the costs.

Fred Snow W2IFR
Big Look Trail
Medford NJ 08055

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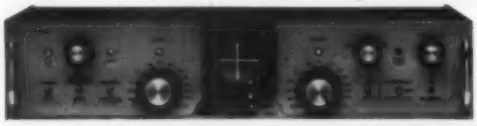

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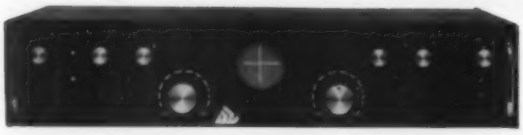

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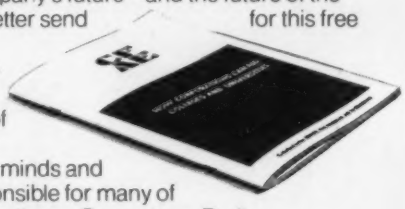

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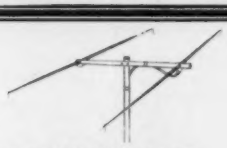

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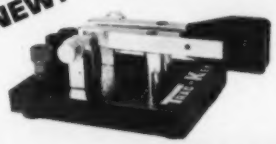

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1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
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4040	.75
4041	.69
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4043	.50
4044	.65
4046	1.25
4049	.45
4050	.45
4066	.55
4069/74C04	.25
4071	.25
4081	.30
4082	.30
MC 14409	14.50
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4511	.95
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7400	.10	7473	.25	74176	.85	74H72	.35
7401	.15	7474	.30	74180	.55	74H101	.75
7402	.15	7475	.35	74181	2.25	74H103	.55
7403	.15	7476	.40	74182	.75	74H106	.95
7404	.10	7480	.55	74190	1.25		
7405	.25	7481	.75	74191	.95	74L00	.25
7406	.25	7483	.75	74192	.75	74L02	.20
7407	.55	7485	.55	74193	.85	74L03	.25
7408	.15	7486	.25	74194	.95	74L04	.30
7409	.15	7489	1.05	74195	.95	74L10	.20
7410	.15	7490	.45	74196	.95	74L20	.35
7411	.25	7491	.70	74197	.95	74L30	.45
7412	.25	7492	.45	74198	1.45	74L47	1.95
7413	.25	7493	.35	74221	1.00	74L51	.45
7414	.75	7494	.75	74367	.75	74L55	.65
7416	.25	7495	.60			74L72	.45
7417	.40	7496	.80	75108A	.35	74L73	.40
7420	.15	74100	1.15	75491	.50	74L74	.45
7426	.25	74107	.25	75492	.50	74L75	.55
7427	.25	74121	.35			74L93	.55
7430	.15	74122	.55			74L123	.85
7432	.20	74123	.35	74H00	.15		
7437	.20	74125	.45	74H01	.20	74S00	.35
7438	.20	74126	.35	74H04	.20	74S02	.35
7440	.20	74132	.75	74H05	.20	74S03	.25
7441	1.15	74141	.90	74H08	.35	74S04	.25
7442	.45	74150	.85	74H10	.35	74S05	.35
7443	.45	74151	.65	74H11	.25	74S08	.35
7444	.45	74153	.75	74H15	.45	74S10	.35
7445	.65	74154	.95	74H20	.25	74S11	.35
7446	.70	74156	.70	74H21	.25	74S20	.25
7447	.70	74157	.65	74H22	.40	74S40	.20
7448	.50	74161	.55	74H30	.20	74S50	.20
7450	.25	74163	.85	74H40	.25	74S51	.25
7451	.25	74164	.60	74H50	.25	74S64	.15
7453	.20	74165	1.10	74H51	.25	74S74	.35
7454	.25	74166	1.25	74H52	.15	74S112	.60
7460	.40	74175	.80	74H53J	.25	74S114	.65
7470	.45			74H55	.20		
7472	.40						

74S133	.40
74S140	.55
74S151	.30
74S153	.35
74S157	.75
74S158	.30
74S194	1.05
74S257 (8123)	1.05
74LS00	.20
74LS01	.20
74LS02	.20
74LS04	.20
74LS05	.25
74LS08	.25
74LS09	.25
74LS10	.25
74LS11	.25
74LS20	.20
74LS21	.25
74LS22	.25
74LS32	.25
74LS37	.25
74LS38	.35
74LS40	.30
74LS42	.65
74LS51	.35
74LS74	.35
74LS86	.35
74LS90	.55
74LS93	.55
74LS107	.40
74LS123	1.00
74LS151	.75
74LS153	.75
74LS157	.75
74LS164	1.00
74LS193	.95
74LS367	.75
74LS368	.65

9000 SERIES

9301	.85	95H03	1.10
9309	.35	9601	.20
9322	.65	9602	.45

LINEARS, REGULATORS, etc.

MCT2	.95
8038	3.95
LM201	.75
LM301	.45
LM308 (Mini)	.95
LM309H	.65
LM309K (340K-5)	.85
LM310	.85
LM311D (Mini)	.75
LM318 (Mini)	1.75
LM320K5(7905)	1.65
LM320K12	1.65
LM320T5	1.65
LM320T12	1.65
LM320T15	1.65
LM324N	1.25
LM339	.75
7805 (340T5)	.95
LM340T12	.95
LM340T15	.95
LM340T18	.95
LM340T24	.95
LM340K12	1.25
LM340K15	1.25
LM340K18	1.25
LM340K24	1.25
78L05	.75
78L12	.75
78L15	.75
78M05	.75
LM373	2.95
LM380 (8-14 PIN)	.95
LM709 (8,14 PIN)	.25
LM711	.45
LM723	.40
LM725N	2.50
LM739	1.50
LM741 (8-14)	.25
LM747	1.10
LM1307	1.25
LM1458	.65
LM3900	.50
LM75451	.65
NE555	.35
NE556	.85
NE565	.95
NE566	1.25
NE567	.95

MICRO'S, RAMS, CPU'S, E-PROMS

74S188	3.00	8214	8.95
1702A	4.50	8224	3.25
MM5314	3.00	8228	6.00
MM5316	3.50	8251	8.50
2102-1	1.45	8255	10.50
2102L-1	1.75	8T13	1.50
2114	9.50	8T23	1.50
TR1602B	3.95	8T24	2.00
TMS 4044-	9.95	8T97	1.00
		21078-4	4.95
8080	8.95	2708	9.50
8212	2.95	Z80 PIO	8.50

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$35 - $99	10%
$100 - $300	15%
$301 - $1000	20%

THIS SPECIAL ONE CENT SALE IS FOR MAGAZINE ADS ONLY

POLY PAKS' 1¢ REVOLUTION

THESE ONE-CENTERS ARE THE CENT-CIBLE WAY TO SHOP AND SAVE!

Cat. No. 7A5267 Men's LED

LED WATCH GUTS

Factory "toy-arounds". Do they work? Who knows! A micro-digital technician's bonanza. Gets are there. Some units even have batteries. LED types display HOURS, MINUTES, SECONDS, MONTH, and DATE. Sorry, no specs.

$1.95 2 for 1.96

TTL'S AT "CENT-CIBLE" PRICES

Order By Cat. No. 7A1961 & Type No.

Type	Each	2 for
☐ SN7400	$ .19	$ .20
☐ SN7401	.19	.20
☐ SN7403	.25	.26
☐ SN7405	.19	.20
☐ SN7406	.39	.40
☐ SN7407	.39	.40
☐ SN7409	.39	.40
☐ SN7410	.25	.26
☐ SN7411	.59	.60
☐ SN7413	.69	.70
☐ SN7414	.99	1.00
☐ SN7416	.35	.36
☐ SN7417	.35	.36
☐ SN7420	.33	.33
☐ SN7421	.49	.50
☐ SN7423	.39	.40
☐ SN7426	.19	.20
☐ SN7430	.29	.30
☐ SN7432	.33	.33
☐ SN7437	.19	.20
☐ SN7438	.25	.26
☐ SN7440	.19	.20
☐ SN7442	.69	.70
☐ SN7443	.59	.60
☐ SN7444	.39	.40
☐ SN7445	1.00	1.00
☐ SN7446	1.25	1.26
☐ SN7447	1.25	1.26
☐ SN7448	1.35	1.36
☐ SN7450	.19	.20
☐ SN7451	.19	.20
☐ SN7453	.19	.20
☐ SN7454	.29	.30
☐ SN7455	.19	.20
☐ SN7460	.19	.20
☐ SN7462	.19	.20
☐ SN7464	.19	.20
☐ SN7465	.19	.20
☐ SN7470	.19	.20
☐ SN7471	.19	.20
☐ SN7472	.19	.20
☐ SN7473	.39	.40
☐ SN7474	.25	.26
☐ SN7475	.69	.70
☐ SN7476	.79	.80
☐ SN7480	.19	.20
☐ SN7482	.29	.30
☐ SN7483	.99	1.00
☐ SN7486	.49	.50
☐ SN7488	.79	.80
☐ SN7489	2.49	2.50
☐ SN7490	.99	1.00
☐ SN7491	1.29	1.30
☐ SN7492	.69	.70
☐ SN7493	.69	.70
☐ SN7494	.79	.80
☐ SN7495	.59	.60
☐ SN7496	.75	.76
☐ SN7498	.79	.80
☐ SN74100	1.99	2.00
☐ SN74107	.29	.30
☐ SN74112	.39	.40
☐ SN74113	.39	.40
☐ SN74114	.25	.26
☐ SN74121	.49	.50
☐ SN74123	.69	.70
☐ SN74125	.99	1.00
☐ SN74126	.99	1.00
☐ SN74132	1.35	1.36
☐ SN74136	.49	.50
☐ SN74140	.49	.50
☐ SN74141	1.79	1.80
☐ SN74145	.69	.70
☐ SN74151	1.25	1.26
☐ SN74153	1.25	1.26
☐ SN74154	1.75	1.76
☐ SN74155	.79	.80
☐ SN74156	.39	.40
☐ SN74157	.99	1.00
☐ SN74158	.99	1.00
☐ SN74161	1.25	1.26
☐ SN74164	.79	.80
☐ SN74165	.99	1.00
☐ SN74166	1.99	2.00
☐ SN74173	.99	1.00
☐ SN74174	1.49	1.50
☐ SN74175	.99	1.00
☐ SN74177	.79	.80
☐ SN74179	1.49	1.50
☐ SN74180	.49	.50
☐ SN74182	.49	.50
☐ SN74190	1.99	2.00
☐ SN74191	1.75	1.76
☐ SN74192	.85	.86
☐ SN74193	.99	1.00
☐ SN74194	1.25	1.26
☐ SN74195	.29	.30
☐ SN74197	.75	.76
☐ SN74198	1.50	1.51
☐ SN74200	3.50	3.51
☐ SN74251	.79	.80
☐ SN74284	6.00	6.01
☐ SN74298	3.75	3.76

POP-AMPS AT "CENT-CIBLE" PRICES

Case code: T=TO-220 Power Tab; V=Mini dip; K=TO-3; H=TO-5; N=DIP.

Type No.	Each	2 for
☐ LM300H	$ .79	$ .80
☐ LM300N	.49	.50
☐ LM301V	.45	.46
☐ LM301N	.45	.46
☐ LM307V	.45	.46
☐ LM308V	.69	.70
☐ LM308H	.69	.70
☐ LM309K	1.49	1.50
☐ LM311V	.79	.80
☐ LM311H	1.49	1.50
☐ LM311N	.99	1.00
☐ LM320H-5	.99	1.00
☐ LM320H-12	.99	1.00
☐ LM320H-15	.99	1.00
☐ LM320T-5	1.49	1.50
☐ LM320T-6	1.49	1.50
☐ LM322N	1.19	1.20
☐ LM323K	1.79	1.80
☐ LM339N	1.79	1.80
☐ LM340K-5	1.49	1.50
☐ LM340K-6	1.49	1.50
☐ LM340K-8	1.49	1.50
☐ LM340K-12	1.49	1.50
☐ LM340K-15	1.49	1.50
☐ LM340K-18	1.49	1.50
☐ LM340K-24	1.49	1.50
☐ LM340T-5	1.49	1.50
☐ LM340T-6	1.49	1.50
☐ LM340T-8	1.49	1.50
☐ LM340T-12	1.49	1.50
☐ LM340T-15	1.49	1.50
☐ LM340T-18	1.49	1.50
☐ LM340T-24	1.49	1.50
☐ LM350N	.49	.50
☐ LM370N	1.99	2.00
☐ LM376V	.29	.30
☐ LM377N	2.25	2.26
☐ LM380N	1.39	1.40
☐ LM381N	1.99	2.00
☐ LM386N	1.49	1.50
☐ LM531N	1.49	1.50
☐ LM532N	.25	.26
☐ LM532H	.25	.26
☐ LM533N	1.49	1.50
☐ LM555V	.75	.76
☐ LM556N	1.79	1.80
☐ LM556V	.39	.40
☐ LM558N	.59	.60
☐ LM561N	1.00	1.01
☐ LM565N	1.00	1.01
☐ LM566N	1.00	1.01
☐ LM566	2.49	2.50
☐ LM567	2.39	2.40
☐ LM703N	.59	.60
☐ LM704H	.19	.20
☐ LM709H	.19	.20
☐ LM709N	.49	.50
☐ LM710N	.39	.40
☐ LM733N	.79	.80
☐ LM741V	.25	.26
☐ LM741H	.39	.40
☐ LM747H	.59	.60
☐ LM1304	1.49	1.50
☐ LM1310	1.79	1.80
☐ LM1312	2.49	2.50
☐ LM1414V	.19	.20
☐ LM1458V	.39	.40
☐ LM1458N	.39	.40
☐ LM3028N	.65	.66
☐ LM3900N	.49	.50
☐ LM3909V	1.75	1.76
☐ LM4250	1.20	1.21
☐ LM75451	.69	.70
☐ LM75453	.80	.70
☐ LM75491	.80	.81
☐ LM75492	.80	.81
☐ LM75494	.80	.81
☐ PA263	1.50	1.51
☐ DM8864N	1.39	1.30

RIBBON CABLE!

Order by Cat. 7A 3939 and Conductors

Cond.	Sale	1¢ Sale
☐ 20	7-ft. $1.98	14-ft. $1.99
☐ 26	4-ft. 1.98	8-ft. 1.99
☐ 34	3-ft. 1.98	6-ft. 1.99
☐ 40	3-ft. 1.98	6-ft. 1.99

25 AMP BRIDGE RECTIFIERS

Order by Cat. No. 7A2273 & voltage

V	Each	1¢	SALE
☐ 50	$1.98	2 for	$1.98
☐ 100	1.49	2 for	1.50
☐ 200	1.69	2 for	1.70
☐ 400	1.99	2 for	2.00
☐ 600	2.49	2 for	2.50
☐ 800	2.50	2 for	2.51

25 AMP POWER STUD SCRS, TRIACS

Cat. No. 7A-14A147 (SCRs)

Cat. No. 7A-60B86A (Triacs)

V.	Each	1¢	SALE
☐ 50	$ .95	2 for	$ .96
☐ 100	1.25	2 for	1.26
☐ 200	1.95	2 for	1.96

1N4000 Epoxy Rectifiers

• Miniature! • 1.5 Amp!

Cat. No.	Type No.	PIV	Price	1¢ MORE!
☐ 7A2377	1N4001	50	10 for $.85	20 for .86
☐ 7A2378	1N4002	100	10 for .75	20 for .76
☐ 7A2379	1N4003	200	10 for .85	20 for .86
☐ 7A2380	1N4004	400	10 for .99	20 for 1.00
☐ 7A2381	1N4005	600	10 for 1.29	20 for 1.30
☐ 7A2382	1N4006	800	10 for 1.39	20 for 1.40
☐ 7A2383	IN4007	1000	10 for 1.49	20 for 1.50

10 AMP - POWER TABS!

Order by Cat. and Type No.

☐ #7A1648 - TRIACS

☐ 7A1739 - SCR

☐ #7A1590 - QUADRACS

PRV	Each	2 for
☐ 50	$ .35	$ .36
☐ 100	.69	.70
☐ 200	.85	.86
☐ 400	1.19	.99 1.30

1.5 AMP BULLET RECTIFIERS!

Order by Cat. No. 7A60B94 and voltage

☐ 50V	10 for $.59	20 for $.60
☐ 100V	10 for .69	20 for .70
☐ 200V	10 for .79	20 for .80
☐ 400V	10 for .89	20 for .90

MICRO MINI TOGGLE SWITCHES!

3 Amps, 125 VAC contacts. with chrome handles, complete with mounting hardware.

Cat. No.	Type	Sale	2 for
☐ 7A3236	SPST	$1.19	$1.20
☐ 7A5085	SPDT	1.39	1.40
☐ 7A4037	DPDT	1.45	1.46

• CENTER-OFF

BUY 1 AT OUR SALE PRICE GET 2nd FOR 1¢ MORE

LYTIC KLINIC

Electrolytic capacitors

Order by Cat. No. 7A3209 and value

UF	V	Style	Sale	1¢ SALE
☐ 10	15	P.C.	10 for $1.00	20 for $1.01
☐ 50	15	P.C.	8 for 1.00	16 for 1.01
☐ 15	25	P.C.	8 for 1.00	16 for 1.01
☐ 50	25	P.C.	6 for 1.00	12 for 1.01
☐ 20	15	Axial	10 for 1.00	20 for 1.01
☐ 20	15	P.C.	10 for 1.00	20 for 1.01

6 AMP CARTWHEEL RECTIFIERS

Cat. No. 7A3584

PRV	Each	1¢	SALE
☐ 50	$ .36	2 for	$ .37
☐ 100	.41	2 for	.42
☐ 200	.41	2 for	.42
☐ 400	.79	2 for	.80
☐ 600	.90	2 for	.91
☐ 800	1.19	2 for	1.20
☐ 1000	1.39	2 for	1.40

BUY 1 AT OUR SALE PRICE GET 2nd FOR 1¢ MORE

LEDS!

YOUR CHOICE 5 for $1.00 1¢ SALE 10 for $1.01

Order by Cat. No.

☐ #7A2135 JUMBO RED LEDS

☐ #7A2137 MICRO RED LEDS

☐ #7A2750 JUMBO RED CLEAR LEDS

ZENERS!

Order by Cat. No. 7A5210 & voltage & wattage

1 Watt	Sale	1¢ SALE
☐ 7.5V	5 for $1.	10 for $1.01
☐ 8.2V	5 for 1.	10 for 1.01
☐ 9.1V	5 for 1.	10 for 1.01
☐ 11.V	5 for 1.	10 for 1.01
☐ 12.V	5 for 1.	10 for 1.01
☐ 15.V	5 for 1.	10 for 1.01

Order by Cat. No. 7A5210B

5 WATTS	Sale	1¢ SALE
☐ 3.3V	3 for $1.	6 for $1.01
☐ 5.1V	3 for 1.	6 for 1.01
☐ 6.2V	3 for 1.	6 for 1.01
☐ 8.2V	3 for 1.	6 for 1.01
☐ 9.1V	3 for 1.	6 for 1.01
☐ 12. V	3 for 1.	6 for 1.01
☐ 15. V	3 for 1.	6 for 1.01
☐ 18. V	3 for 1.	6 for 1.01
☐ 24. V	3 for 1.	6 for 1.01
☐ 30. V	3 for 1.	6 for 1.01

SALE

BUY ONE AT SALE PRICE, GET 2ND FOR ONLY 1¢ MORE.

Easy to build. Both units are 12 or 24 hours. Easy to bread-board, uses MM5316 clock chip and a minimum of external components. AM/PM indicator, includes options for alarm, clock radio, snooze, and more. Basic kits include IC's, sockets, transistors, readouts and all other necessary components. (case, PC board, transformer, and line cord not included). Fluorescent basic includes .57" BRIGHT BLUE "NIXIE" TUBES. LED basic includes .35" RED LED READOUTS.

☐ Cat. No. #7A3791 Fluorescent Basic Clock Kit $9.95 2 for $9.96

☐ Cat. No. #7A4092 LED Basic Clock Kit 9.95 2 for 9.96

☐ Cat. No. #7A3412 12V 300 ma Transformer 1.49 2 for 1.50

☐ Cat. No. #7A3792 Components for Optional Alarm 2.95 (no 1¢ sale)

4 DIGIT Wt. 1 lb. Your Choice $9.95 2 for $9.96

FLUORESCENT - LED CLOCK BASICS

Parts & Semi One Centers

Quan.	Description (Order by Cat. No. in parenthesis)	Sale	1¢SALE
☐ 5	PANCAKE PHOTOCELLS, 600 to 15K ohms (7A2939)	1.00	10 for 1.01
☐ 1	100KHZ MARKER CRYSTALS, approx for marker gen. (7A3896)	1.95	2 for 1.96
☐ 1	MOTHERBOARD EDGE CONNECTOR, 106 pins, .125" (7A3987)	3.50	2 for 3.51
☐ 1	48-PIN EDGE CONNECTOR, .156" spacing (7A3063)	1.95	2 for 1.96
☐ 2	LCD THERMAL INDICATORS, 80-108°F, 7x1", flexible (#7A5195)	1.00	4 for 1.01
☐ 1	JOYSTICK, four 100K pots, with knob (#7A3508A)	4.95	2 for 4.96
☐ 1	ESCO THUMBWHEEL SWITCH, BCD, 0-7 (#7A2870A)	1.49	2 for 1.50
☐ 1	8-TRACK TAPE TRANSPORT, with preamps (#7A3010)	9.95	2 for 9.96
☐ 1	PLESSEY TV SIDEBAND FILTER, for chan. 3 or 4 (#7A3975)	1.95	2 for 1.96
30-Ft.	WIRE WRAP WIRE, 30 gage, for ICs, terminals (#7A3603)	1.00	00-Ft for 1.01
☐ 1	METER, 50uA, 1½" square, 0-20db (#7A3705)	1.19	2 for 1.20
☐ 1	SPST RELAY, norm. open 12-24 VDC, 1250 ohms, dip style (#7A5175)	1.00	2 for 1.01
☐ 1	VEEDER ROOT COUNTER, 000-999, resettable, panel mt. (#7A5081)	1.49	2 for 1.50
☐ 2	DUAL GATE MOSFET, sim. to 3N200, 3N187, for RF & Mixer (#7A5101)	1.00	4 for 1.01
☐ 1	8-TRACK TAPE HEAD, with plug' n' cord (#7A3468)	1.50	2 for 1.51
☐ 10	CALCULATOR KEYBOARDS, 20 keys and more (7A3524)	$2.00	20 for $2.01
☐ 10	CRYSTALS, may include CB, Ham & more (7A3250)	2.00	20 for 2.01
☐ 150	MOLEX IC SOCKETS, on a strip, cut to length (7A3144)	2.00	300 for 2.01
☐ 100	TERMINAL STRIPS, from 2 lugs up (7A3136)	2.00	200 for 2.01
☐ 20	NE-2NEON LAMPS, all 100% good (7A2613)	2.00	40 for 2.01
40-Ft.	SHIELDED CABLE, 1 cond, mikes, phones, (#7A3577)	2.00	80 Ft. for 2.01
☐ 50	TRANSISTOR ELECTROS, assstd values, styles (7A2747)	2.00	100 for 2.01
☐ 3	SOUND TRIGGERS, sound triggers ocr w/amp (7A3625)	2.00	6 for 2.01
☐ 10	CB CRYSTALS, for phase lock loop, HAM, MC/18 (#7A5059)	2.00	20 for 2.01
☐ 100	DISC CAPACITORS, long leads, marked, asst'd (#7A2598)	2.00	200 for 2.01
☐ 100	CAPACITOR SPECIAL, discs, mylar, lytics, more (7A3738)	2.00	200 for 2.01
☐ 10	VOLTAGE REGULATORS, hobby LM320, 340, TO-3 (7A3330)	2.00	20 for 2.01
☐ 30	PANEL SWITCHES, slides, rotaries, mod, etc (7A3268)	2.00	60 for 2.01
☐ 200	RESISTOR SPECIAL, ¼ to 1W, carbon, metal (7A3054)	2.00	400 for 2.01
☐ 200	HALF WATTERS, resistors, carbon, metal (7A3046)	2.00	400 for 2.01
☐ 100	NATIONAL IC BONANZA, linears, 7400s ROMS (7A2860)	2.00	200 for 2.01
☐ 15	LM340T VOLTAGE REGULATORS, 5 to 24V, TO-220 (7A2635)	2.00	30 for 2.01
☐ 100	TWO WATTERS, resistors, carbon-metal marked (7A2735)	2.00	200 for 2.01
☐ 100	POLYSTYRENE CAPS, assstd values, voltage, hi-Q (7A2729)	2.00	200 for 2.01
☐ 50	THERMISTORS, resistors that change with temp (7A4088)	2.00	100 for 2.01
☐ 20	BRIDGES, untested, 2, 4, 6, 10, amp, 50 to 1000 piv (7A4022)	2.00	40 for 2.01
☐ 25	LAMP'N'SOCKET SETS, micro, 1.5V, T2 (7A3957)	2.00	50 for 2.01
☐ 15	MIXED READOUTS, hobby, untested, .127, .3, .5, etc. (7A3619)	2.00	30 for 2.01
☐ 150	QUARTER WATTERS, resistors, metal film, marked (7A3413)	2.00	300 for 2.01
☐ 100	PLASTIC TRANSISTORS, untested, TO-92 (7A2604)	2.00	200 for 2.01
☐ 200	PREFORMED RESISTORS, ¼, ½, 1W, marked, assstd (7A3508)	2.00	400 for 2.01
☐ 200	PRECISION RESISTORS, ¼, ½, 1W, 1%, 2% marked (7A3428)	2.00	400 for 2.01
☐ 60	DIPPED MYLARS, 100V, assst values (7A2597)	2.00	120 for 2.01
☐ 30	VOLUME CONTROLS, audio, linear, assstd values (7A2431)	2.00	60 for 2.01
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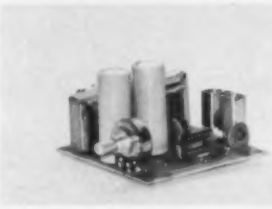

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32 Fair FSA 2812M
32 Fair FSA 2813M
3 56 pin connectors
19 Beckman Pts.
Plus: Over 200 other parts to include tantalum caps, etc. ICs with full leads easily removed. Cost Univac over $1900.00
New $16.95 only 50

MIN. TRANSFORMER

Primary 400 Ohm
Secondary—
300 Ohm
.60 ea
2/1.00

DIODE

Microwave Diode
IN23B—Sylvania
100 MC—150 KMC
$.60
2/1.00

COUNTERS

Veeder Root
120V 50/60 Cycle
5 place—approx.
1¾"W x 1"H x 2"L
*RFE $2.50

RESISTORS-CC

¼W—5%
Ay Value
20—1.00
50—2.00
100—3.50
Please State Value

BANANA PLUG

Red or Black
.30
4/1.00
10/2.25

WHAT'S IT

We don't know
but maybe you
do. Has motors
gears, micro switch
*RFE $1.50

TIP PLUGS

Red and Black
.12 each
10/1.00
25/2.00

DISC CAPS

.01—100V
¼" Lead Spacing
ARCO TCP-RO1
20/$1.00

POTS

CTS ½" Bushing
½" shaft
10K—$.35
100K—$.35
4 meg/40K dual
$.75

BINDING POST

5 Way Red
5 Way White
Your Choice
.40 ea
3/1.00

BOURNS TRIMPOT

#3260H 10K—10 Turn
¼" Square—Wirewound
Retails for $11.55
Special this month only
$5.95

TERMS: Orders under $15.00 add 2.00 for handling—cods accepted with 25% deposit on orders over $25.00. Fla. residents add 4% sales tax—all material fully guaranteed. ***rfe-removed from equipment**

NEW Frequency Counter $89.95 kit

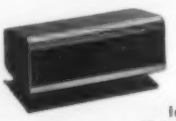
UTILIZES NEW MOS-LSI CIRCUITRY

You've requested it, and now it's here! The CT-50 frequency counter kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 V dc as it does on 110 V ac. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $89.95. Order yours today!

CT-50, 60 MHz counter kit ..... $ 89.95
CT-50 WT, 60 MHz counter, wired and tested 159.95
CT-600, 600 MHz prescaler option for CT-50, add 29.95

SPECIFICATIONS
Sensitivity: less than 25 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 2.0 ppm, .001 ppm with TV time base!
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case

Color burst adapter for .001 ppm accuracy
CB-1, kit $14.95



CLOCK KIT
6 digit 12/24 hour

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, bronze, blue (specify).

Clock kit, DC-5 ..... $22.95
Alarm clock, DC-8, 12 hr only 24.95
Mobile clock, DC-7 ..... 25.95
Clock kit with 10 min ID timer, DC-10 ... 25.95
Assembled and tested clocks available, add $10.00

CHEAP CLOCK KIT $8.95

DC-4 Features:
- 6 digit .4" LED
- 12 or 24 format

Does not include board or transformer

PC Board $2.95
Transformer $1.49

VIDEO TERMINAL KIT $149.95

A compact 6 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor. Keyboard/computer control backspace, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit $149.95
TH3216, Assembled and Tested 239.95
VD-1, Video to RF Modulator Kit 6.95

CAR CLOCK KIT $27.95

12/24 Hour 12 Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo .4" LED readouts
- Easy, no-polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC-11 ..... $27.95

AUTO-DIMMER $2.00
Automatically adjusts display brightness according to ambient light level. For DC-11 Car Clock.

MINI-KITS

TONE DECODER KIT
A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 ..... $4.95

SUPER SLEUTH AMPLIFIER
A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.
Complete Kit, BN-9 ..... $4.95

FM WIRELESS MIKE KIT
Transmit up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9 V. Type FM-2 has added super sensitive mike preamp.
FM-1 ..... $2.95 FM-2 ..... $4.95

COLOR ORGAN/MUSIC LIGHTS
See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.
Complete Kit, ML-1 ..... $7.95

LED BLINKY KIT
A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.
Complete Kit $2.95

POWER SUPPLY KIT
Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.
Complete Kit, PS-3LT $6.95

SIREN KIT
Produces upward and downward wail characteristic of police siren. 5 watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 ..... $2.95

DECADE COUNTER PARTS
Includes: 7490A, 7475, 7447, LED readout, current limit resistors, and instructions on an easy to build low cost frequency counter.
Kit of parts, DCU-1 ..... $3.50

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. Specify ÷10 or ÷100
Wired, tested, PS-1B $59.95
Kit, PS-1B $44.95

30 watt 2 meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out, incredible value, complete with all parts, instructions and details on T-R relay. Case not included.
Complete Kit, PA-1 ..... $22.95

CALENDAR ALARM CLOCK

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car!
FEATURES:
- 6 Digits, .5" High LED
- Calendar shows mo./day
- True 24 Hour Alarm
- Battery back up with built-in on chip time base
- 12/24 Hour Format
- Snooze button
- 7001 chip does all!!

Complete Kit, less case, DC-9 ..... $34.95

		LINEAR		REGULATOR		TRANSISTORS	
5314 Clock	$2.95	555	$ .50	78MG	$1.49	MRF-238 30W VHF	$11.95
74S00	.35	556	.75	309k	.89	NPN 2N3904 type	10/$1.00
74S112	.75	566	1.49	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.49	340K-12	.99	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.89	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.89	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.89	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.89	2N3055 NPN Power	.75

SPECIAL

DIODES: 1KV,2.5A ..... 5/$1.00 100V,1A ..... 10/$1.00 1N914A type ..... 50/$2.00

LED DISPLAYS

FND 359 ..... .75
FND 510 ..... 1.25
DL 707 ..... 1.25
HP 7730 ..... 1.25
Red Polaroid Filter ... 4.25" X 1.125" ... .50

741 OP-AMP SPECIAL
Factory prime mini dip with both Xerox and 741 part numbers
10 for $2.00

SOCKETS

14 PIN	5/$1.00
16 PIN	5/$1.00
24 PIN	2/$1.00
40 PIN	3/$2.00

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with info and specs
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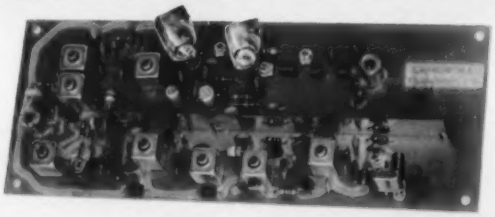
Satisfaction guaranteed or money refunded. COD, add $1.00. Orders under $10 add $.75. NY residents add 7% tax. Add 5% for postage, insurance, and handling. Minimum order $6.00.

AT LAST! A 2 METER SSB TRANSVERTER

At a price you can afford

Use inexpensive recycled 10 or 11 meter ssb exciter on 2 meters.



FEATURES:

- Linear Converter for SSB, CW, FM, etc.
- A fraction of the price of other units
- 2W p.e.p. output with 5 MW of drive
- Use low power tap on exciter or attenuator pad
- Easy to align with built-in test points

VX2-( ) TRANSVERTER KIT $59.95
A25 Optional Cabinet for Xverter&PA $20

Frequency Schemes Available:

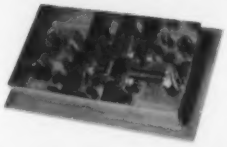
VX2-4	28-30 = 144-146	Other frequency ranges available on special order
VX2-5	28-29 = 145-146	
VX2-6	26-28 = 144-146	

2M LINEAR POWER AMPLIFIERS:

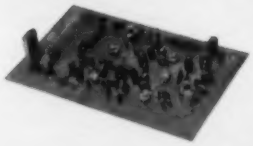
LPA 2-15 Kit	15 W p.e.p.	$69.95
LPA 2-70 Kit	70 W p.e.p.	$139.95

New VHF&UHF Converter Kits

let you receive OSCAR signals and other exciting SSB, CW,& FM activity on your present HF receiver.



either one
-ONLY $34.95
including crystal



MODEL	RF RANGE (MHZ)	I-F RANGE
C50	50-52	28-30
C144	144-146	28-30
C145	145-147 (OSCAR)	28-30
C146	146-148	28-30
C110	Aircraft	28-30
C220	220 band	28-30
Special	Other i-f & rf ranges available	

MODEL	RF RANGE (MHZ)	I-F RANGE
C432-2	432-434	28-30
C432-5	435-437(OSCAR)	28-30
C432-7	427.25	61.25
C432-9	439.25	61.25
Special	Other i-f & rf ranges available	

A9 Extruded Alum Case/Connectors $12.95

THINKING ABOUT OSCAR?

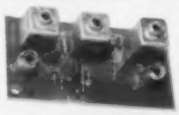
Here are some helpful suggestions -

FAMOUS HAMTRONICS PREAMPS

let you hear the weak ones!

Great for OSCAR, SSB, FM, ATV. Over 10,000 in use throughout the world on all types of receivers.

P9 Kit $12.95
P14 Wired $24.95



Deluxe vhf model for applications where space permits.

- 1-1/2 x 3" • Covers any 4 MHz band • 12 Vdc
- Ideal for OSCAR • Diode protection • 20dB gain

MODEL	RANGE
P9-LO	26-88 MHz
P9-HI	88-172 MHz
P9-220	172-230 MHz
P14 Wired	Give exact band

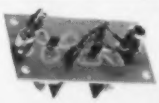
P8 Kit $10.95
P16 Wired $21.95

Miniature VHF model for tight spaces - size only 1/2 x 2-3/8 inches.

- Covers any 4 MHz band
- 20 dB gain • 12 Vdc

MODEL	RANGE
P8-LO	20-83 MHz
P8-HI	83-190 MHz
P8-220	220-230 MHz
P16 Wired	Give exact band

P15 Kit $18.95
P35 Wired $34.95



- Covers any 6 MHz band in UHF range of 380-520 MHz
- 20 dB gain • Low noise

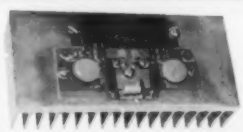
FM/CW TRANSMITTER KITS

BUILD UP YOUR OWN GEAR FOR OSCAR CW OPERATION, FM REPEATERS, CONTROL LINKS

- Professional Sounding Audio • Free of Spurs
- Completely Stable • Built-in Testing Aids

T40 11 Channel 200 MW Exciter Kit for 2M or 6M band..... $39.95

T20 Tripler/Driver Kit. Use with T40 for operation on 432-450 MHz band..... $19.95



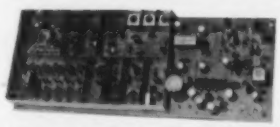
T80 RF POWER AMPLIFIER MODULES FOR ABOVE

- No tuning • VSWR Protected • Wired and Tested
- Rated for Continuous Duty - Great for Repeaters

T80-150: 140-175 MHz, 20-25W output $79.95
T80-450: 430-470 MHz, 13-15W output $79.95

VHF/UHF FM RCVR KITS

- ★ NEW GENERATION RECEIVERS
- ★ MORE SENSITIVE ★MORE SELECTIVE (70 or 100 dB)
- ★ COMMERCIAL GRADE DESIGN
- ★ EASY TO ALIGN WITH BUILT-IN TEST CKTS
- ★ LOWER OVERALL COST THAN EVER BEFORE



R70 6-channel VHF Receiver Kit for 2M, 6M, 10M, 220 MHz, or com'l bands..... $69.95
Optional xtal filter for 100 dB adj chan 10.00

R90 UHF Receiver Kit for any 2 MHz segment of 380-520 MHz band..... $89.95

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40 PAGE CATALOG IS YOURS FOR THE ASKING!

IT'S EASY TO ORDER!

- CALL OR WRITE **NOW** FOR **FREE** CATALOG OR TO PLACE ORDER!
- PHONE 716-663-9254. (Answering service evenings and weekends for your convenience. Personal service 9-5 eastern time.)
- Use credit card, c.o.d., check, m.o.
- Add $2.00 shipping & handling.

IN CANADA, send to Comtec; 5605 Westluke Ave; Montreal, Que H4W 2N3 or phone 514-482-2640. Add 28% to cover duty, tax, and exchange rate.

hamtronics, inc.

182-D Belmont Rd; Rochester, NY 14612 H16

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P.O. Box 19442E Dallas, TX. 75219 (214)823-3240

MC3301P HOUSE #
4 OP AMPS IN ONE PACKAGE. USES SINGLE SUPPLY, (4 to 28VDC). INTERNALLY COMPENSATED. SIMILAR TO MC3401, BUT HIGHER GAIN. **49¢**

MC1437P DUAL 709 OP AMP
HIGH OPEN LOOP GAIN, LOW NOISE. 14 PIN DIP **3/1.00**

MC1351P FM-IF AMP AND DISCRIMINATOR
USED IN FM & TV SOUND CIRCUITS. REQUIRES MINIMUM EXTERNAL COMPONENTS. 14 PIN DIP. DIRECT REPLACEMENT FOR HEPC 6060, ECG 748 and MANY OTHERS. HOUSE # **WITH SPECS** **50¢**

HOUSE #
LM3900 QUAD NORTON AMP
WE BOUGHT A LARGE QUANTITY OF THESE HOUSE NUMBERED PARTS AT A BARGAIN PRICE THAT ALLOWS US TO SELL THEM AT A LOW, LOW **39¢**

TIL312 COMMON ANODE READOUT

3" CHARACTER SIZE WITH PINOUT **.65** **6/3.00**

MPF131 N-CHANNEL DUAL GATE MOSFET

50¢
DESIGNED FOR AMPLIFIER AND MIXER APPLICATIONS TO 200 MHZ. PLASTIC CASE. UNITS ARE HOUSE NUMBERED **WITH SPECS.**

IL-1 OPTO ISOLATORS
BY LITRONIX 6 PIN DIP STANDARD PINOUT LED-TRANSISTOR COMBINATION.
50¢
WHILE THEY LAST!

SMALL SKIRTED BLACK INSTRUMENT KNOB.
FITS ¼" SHAFT WITH SET SCREW.
5/1.00

MJ900 - MJ1000
COMPLIMENTARY PNP, NPN **DARLINGTON POWER TRANSISTORS.** 8 AMPS. WE SUPPLY A SCHEMATIC TO BUILD A HIGH POWER (35W) LOW DISTORTION AUDIO AMP WITH ONLY ONE ADDITIONAL TRANSISTOR AND A DOZEN INEXPENSIVE COMPONENTS! TO-3 CASE STYLE **BUY A PAIR FOR**
$3.00!

1N4148 DIODES
LEADS ARE TARNISHED BUT CLEAN UP EASILY. THE BOSS SAYS ***"DUMP 'EM"***...SO CHECK THIS PRICE!
50/1.00

HOUSE # PNP POWER
TO-3
150 WATTS
80 VCEO
10 AMPS

IDENTICAL TO 2N3790 **1.00**

MC1469R POSITIVE VOLTAGE REGULATOR
½ AMP COMPLETE SPECS AND APPLICATIONS SHOW HOW TO BUILD FIXED OR VARIABLE POWER SUPPLIES FROM 3 TO 30VDC. DRIVE EXTERNAL SERIES PASS FOR CURRENT TO 20 AMPS!
1.25 EA.
10/10.00
HOUSE #

FANTASTIC SOUND EFFECTS CHIP
AVAILABLE ONLY FROM BULLET!
THIS 28 PIN MARVEL CONTAINS A LOW FREQUENCY OSCILLATOR, VCO, NOISE OSCILLATOR, ONE SHOT, MIXER AND ENVELOPE CONTROL. WITH 8 PAGE MANUAL. 5 to 9VDC **3.95**

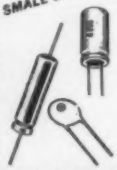
ALL COMPONENTS 100% GUARANTEED

CA3011	WIDEBAND IF AMP w/specs	**50¢**
2N3569	NPN EPOXY 1W	**6/1.00**
741	OP AMP 8 PIN DIP	**5/1.00**
723	VOLTAGE REG. 14 PIN DIP	**50¢**
MPS6530	NPN HOUSE #	**8/1.00**
725	OP AMP LOW NOISE HOUSE #	**99¢**
7815	15V 1A REGULATOR HOUSE #	**69¢**
LM340T-12	12V 1A VOLT. REG. w/specs	**75¢**
TCA430	QUAD OSCILLATOR 1/specs	**69¢**
2N4343	P CHANNEL J FET	**4/1.00**
2N6111	PNP MED PWR 40W TO-220	**3/1.00**
2N6028	PROGRAMMABLE UNIJUNCTION w/specs	**50¢**
TRIAC	200V 8A UNMARKED	**3/1.00**

INCANDESCENT PANEL LAMP
WITH TINNERMAN NUT YOUR CHOICE OF RED, GREEN, YELLOW, WHITE 12-24VDC **15¢**

POWER SUPPLY METERS
Quality 3½" meters for the P-S14, 0-15VDC & 0-25A. Matched set, individually packaged. NOT SURPLUS! **12.95/set**

CAPACITORS
SMALL SIZE!



2200 MFD @ 16 VDC RADIAL **3/1.00**
500 MFD @ 35VDC **5/1.00** AXIAL
220 MFD @ 25VDC **7/1.00** AXIAL
.1 MFD @ 20VDC DISC CERAMIC **15/1.00**

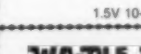
FND510 69¢
COMMON ANODE READOUT ½" CHARACTER
LIMIT 24 PER CUSTOMER!

Miniature 7K Pot w/switch PC Mount or panel mount 1/8" shaft 48 Black plastic knob. Tiny above. **FREE**

LIMITED QTY Computer Grade FILTER CAP Screw Terminals 2" X 5½" 9500 mfd@75V 2.95 or 4/5.99

New! ➡ **ULTRASONIC SENDER RECEIVER KIT US-02** ➡
TOTAL SECURITY! Completely invisible ultrasonic (23KHZ) Sound beam works like a photoelectric beam but is unaffected by light, heat or noise. Separate Transmitter and Receiver can be used from 6 inches to 25 feet! A solid object breaking the beam causes an output to go low that will sink up to 150 MA to Drive a Relay, TRIAC, etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100 MA. Use it for **burglar alarms, object counters, automatic door openers, automatic door bells, electronic rat traps(?) and more.**
COMPLETE KIT LESS CASES **21.50**
Optional entry delay and Alarm Timeout Circuit will source or sink up to 200 MA DC. **3.95**

LED'S JUMBO: RED **5/.89** GREEN **4/.89**



MEDIUM: RED **.15** MINI: RED **.10**
GREEN **.16**
YELLOW **.16**
1.5V 10-30 ma

POWER SUPPLY KIT PS-14
* Better than 200MV load and line regulation
* Foldback Current Limiting
* Short Circuit Protected
* Thermal Shutdown
* Adjustable Current Limiting
* Less than 1% ripple.
* 15 amps 11.5 to 14.5V
* All parts supplied including heavy duty transformer.
* Quality plated fiberglass PC board.

Less Case, meters & jacks

39.95 UPS SHIPPING PAID!

Public Notice!
THE PS-14 HIGH CURRENT POWER SUPPLY KIT HAS BEEN SELLING FOR 39.95 FOR OVER A YEAR. IN EXCESS OF ONE THOUSAND KITS HAVE BEEN SOLD AT THIS PRICE.
WE WOULD LIKE TO GIVE OUR CUSTOMERS A CHANCE TO PURCHASE THE KIT AT THIS PRICE BEFORE A SCHEDULED INCREASE TO 49.00 IN SEPTEMBER.

WARBLE ALARM KIT
A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5–12VDC at up to 1 amp (using 12VDC•8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker. ORDER WB–02
2.50

OVERVOLTAGE PROTECTION KIT
6.95
Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS-12 and PS-14. All electronics supplied. Drilled and plated PC board. (Order OVP-1)

MINI GRANDFATHER CLOCK KIT
Complete Electronics!
* Chimes the hour (ie: 3 times for 3 O'clock)
* Unique "swinging" LED pendulum
* Tick tock sound matches pendulum swing.
* Large 4 digit .5" LED readout
* All CMOS construction
* Complete electronics including transformer & speaker; drilled and plated PC boards measure 4.5" x 6.5"

39.95

BEAUTIFUL SOLID WALNUT
Custom case for above kit. Over 9¾" tall. **19.95**

MK-03A CLOCK/TIMER KIT
Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case.
9–14VDC
28.95

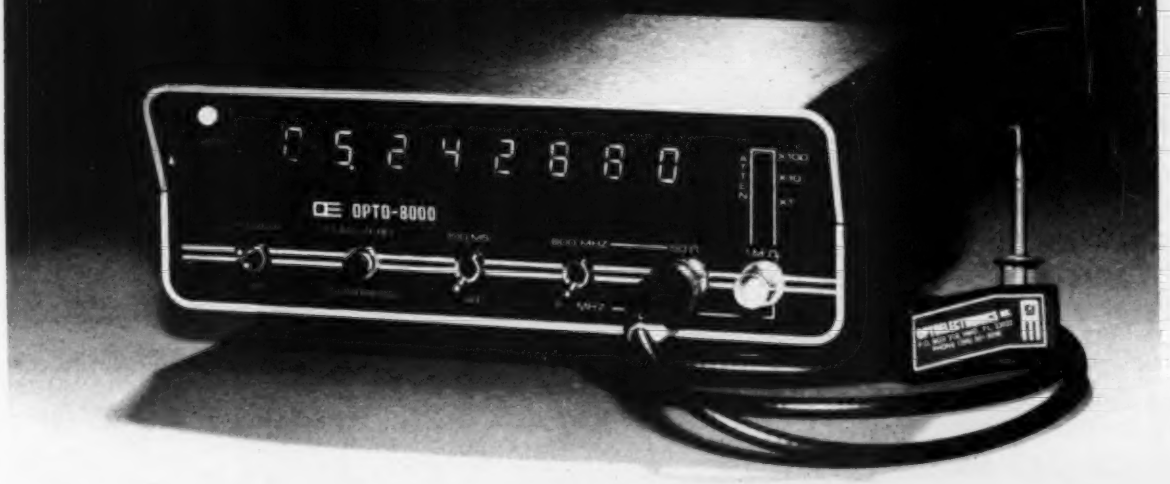
★ NO C.O.D.'S
★ SEND CHECK M.O. OR CHARGE CARD NO.
★ PHONE ORDERS ACCEPTED ON VISA AND MASTERCHARGE ONLY.

★ ADD 5% FOR SHIPPING
★ TX. RES. ADD 5% STATE SALES TAX
★ ORDERS OF $50. & OVER TAKE 10% DISCOUNT
★ FOREIGN ORDERS ADD 10% (20% AIRMAIL) U.S. FUNDS ONLY.

600 MHZ. FREQUENCY COUNTER

±0.1 PPM TCXO

OPTO-8000.1



This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090" thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.

SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3"h x 7½"w x 6½"d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090" thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz
or internal batteries

OPTO-8000.1 Factory Wired	**$299.95**
OPTO-8000.1K Kit	**$249.95**

ACCESSORIES:
Battery-Pack Option—Internal Ni-Cad Batteries and charging unit **$19.95**

Probes:	P-100—DC Probe, may also be used with scope	**$13.95**
	P-101—LO-Pass Probe, very useful at audio frequencies	**$16.95**
	P-102—High Impedence Probe, ideal general purpose usage	**$16.95**

VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H **$12.50**
Right Angle BNC adapter #RA-BNC **$ 2.95**

FC-50 — Opto-8000 Conversion Kits:
Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.

FC-50 — Opto-8000	**Kit $59.95**
*FC-50 — Opto-8000F	**Factory Update $99.95**
FC-50 — Opto-8000.1 (w/TCXO)	**Kit $109.95**
*FC-50 — Opto-8000.1F	**Factory Update $149.95**

*Units returned for factory update must be completely assembled and operational

OPTOELECTRONICS, INC.
5821 NE 14 Avenue
Ft. Lauderdale, FL 33334
Phones: (305) 771-2050 771-2051
Phone orders accepted 6 days, until 7 p.m.

03

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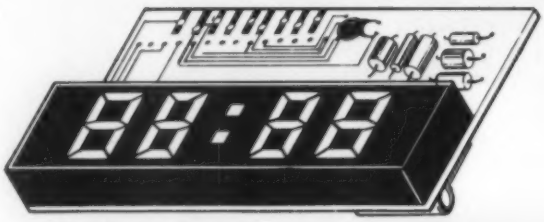
TERMS: Orders to U.S. and Canada, add 5% to maximum of $10.00 per order for shipping, handling and insurance. To all other countries, add 10% of total order. Florida residents add 4% state tax. C.O.D. fee: $1.00. Personal checks must clear before merchandise is shipped.

NATIONAL SEMICONDUCTOR
JUMBO CLOCK MODULE

MA1008A BRAND NEW!



$6.95

2 FOR $13

(AC XFMR $1.95)

FEATURES:
- ★ FOUR JUMBO ½ INCH LED DISPLAYS
- ★ 12 HR REAL TIME FORMAT
- ★ 24 HR ALARM SIGNAL OUTPUT
- ★ 50 OR 60 Hz OPERATION
- ★ LED BRIGHTNESS CONTROL
- ★ POWER FAILURE INDICATOR
- ★ SLEEP & SNOOZE TIMERS
- ★ DIRECT LED DRIVE (LOW RFI)
- ★ COMES WITH FULL DATA

ASSEMBLED! NOT A KIT!

ZULU VERSION!
We have a limited number of the 24 HR Real time version of this module in stock.
#MA1008D — $9.95

PERFECT FOR USE WITH A TIMEBASE.

COMPARE AT UP TO TWICE OUR PRICE!

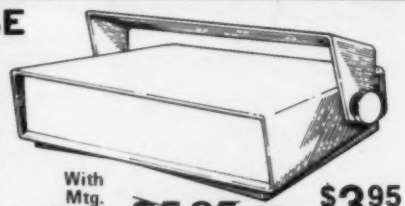
MANUFACTURER'S CLOSEOUT!

SALE! THIS MONTH ONLY!

PRICE CUT!
~~$4.95 ea.~~ **$2.95**

INSTRUMENT CASE

The perfect project enclosure. High impact plastic with aluminum front plate. Front plate can be removed for drilling. 8x2½x4¼ inches. These were originally used for bank security equipment. They are Beautiful! Optional mounting bracket swivels from top to bottom for easy mounting. Knurled thumb screws lock the bracket in any position.



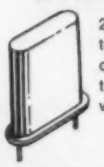
With Mtg. Bracket ~~$5.95 ea.~~ **$3.95**

HIGH FREQUENCY TRANSISTOR

House #2N2369A. NPN Silicon. TO-18 VCE0-20. HFE-100 Typical. Super for RF. FT = 500 MHz. Brand new by ITT. Also subs for the popular 2N706.

10 for $1

EXPERIMENTER'S CRYSTAL



262. 144KHZ. This frequency is 2 to the 18th power. Easily divided down to any power of 2, and even to 1HZ. New by CTS-Knight. A $5 value!

$1.25 each

MALLORY ELECTROLYTIC FILTER CAPACITOR

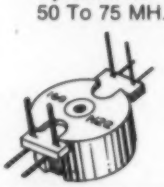
1500 MFD. 16 WVDC. Radial Leads. Factory Fresh!

3 FOR $1 **10 FOR $2.95**

Perfect for Power Supplies! Small Size: 1¼ x ⅝ Inches.

VARIABLE INDUCTOR #2

By Seimens. Pot Core Style. 50 To 75 MH. High Q.

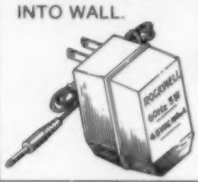


3 FOR $2

75¢

NI-CAD CHARGER

MFG. FOR ROCKWELL. USED ON 5 VDC (4 CELL) PACKS. MAKES A GOOD, CHEAP, DC SUPPLY. PLUGS INTO WALL.



$1.49 EACH

LIMITED STOCK!

MICRO-MINI TOGGLE SWITCH

SPDT. By RAYTHEON. MADE IN USA! WITH HDWR.

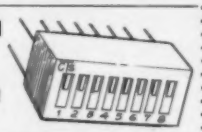
99¢ EACH

6 FOR $5

MINIATURE DIP SWITCH

NEW BY CTS. 8 POSITIONS. FITS A 16 PIN DIP.

$1.95 EACH **BACK IN STOCK!**



CMOS SPECIAL!

CD4001—5 for $1.00 CD4011—5 for $1.00
CD4013—3 for $1.00 CD4040—$1.00 each
CD4042—2 for $1.00 CD4049—3 for $1.00

MOTOROLA VOLTAGE REGULATOR

MC1469R. House Number. TO-66 case. 3 to 30 V at 600 MA output. WITH SPECS.

$1.59

MOTOROLA DUAL GATE MOS-FET

MPF-131. HIGH FREQUENCY. DIODE PROTECTED GATES! DEPLETION MODE. VDS-35V N-CHANNEL. YFS-10,000 MMHOS LOW NOISE.

2 FOR $1

CERAMIC CAPS FOR R.F.

Axial leads, 5% Tolerance. 1.0 or 10.0 PF. 500V.

YOUR CHOICE: **8/$1**

741C OP AMPS

MINI DIP. Prime new units. Has computer MFG's house number.

12/$2. — 100/$15.

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TERMS: Orders under $15. add 75c. No COD's. We accept VISA, MasterCharge and American Express Cards. Money Back Guarantee on all items! Texas Residents add 5% Sales Tax. **WE PAY POSTAGE!**

16K E-PROM CARD

New!

IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

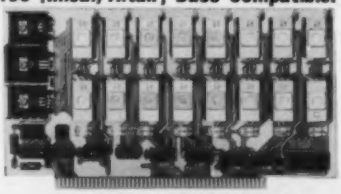
Uses 2708's!

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Double sided PC board with solder mask and silk screen and gold plated contact fingers.
2. Selectable wait states.
3. All address lines & data lines buffered!
4. All sockets included.
5. On card regulators.

KIT INCLUDES ALL PARTS AND SOCKETS (except 2708's). Add $25. for assembled and tested.



DEALER INQUIRIES INVITED!

PRICE CUT!

$57.50 kit

WAS $69.95

SPECIAL OFFER:

Our 2708's (450NS) are $12.95 when purchased with above kit.

Fully Static!

ADD $20 FOR 250NS

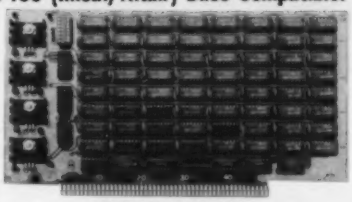
8K LOW POWER RAM KIT-$149.00

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

(450NS)



USES 21L02 RAM'S!

2 KITS FOR $279

Fully Assembled & Burned In $179.00

Blank PC Board w/ Documentation $29.95

Low Profile Socket Set 13.50

Support IC's (TTL & Regulators) $9.75

Bypass CAP's (Disc & Tantalums) $4.50

MOTOROLA QUAD OP - AMP
MC 3401. PIN FOR PIN SUB. FOR POPULAR LM 3900.
3 FOR $1

ALARM CLOCK CHIP
N.S. MM5375AA. Six Digits. With full Data. **New!**
$1.95 each

FULL WAVE BRIDGE
4 AMP. 200 PIV.
69¢ 10 FOR $5.75

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

MOTOROLA 7805R VOLTAGE REGULATOR
Same as standard 7805 except 750 MA output. TO–220. 5VDC output.
44c each or 10 for $3.95

450 NS! 2708 EPROMS
Now full speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4-1702 A's in one package.
$15.75 ea. 4 FOR $50.00

OUR LATEST COMPUTER KIT! **FULLY S-100 COMPATIBLE!** **FULLY STATIC, AT DYNAMIC PRICES!**

16K STATIC RAM KIT

WHY THE 2114 RAM CHIP?
We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Buss! We've all heard the HORROR stories about some Dynamic Ram Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have **clocked** chip enable lines and various timing windows **just as critical** as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the ONLY logical choice for a trouble-free, straightforward design.

BRAND NEW!

$359.00 COMPLETE KIT

SPECIAL INTRODUCTORY OFFER! Buy 2 KITS (32K) for $650 450 NS

Blank PC Board with Documentation $33.00

LOW PROFILE SOCKET SET – $12.00

ASSEMBLED & TESTED – ADD $30.00

2114's 4K RAM's – 8 for $85.00

KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!) Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

Z-80 PROGRAMMING MANUAL
By Mostek. The major Z-80 second source. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A MUST reference manual for any user of the Z-80. 300 pages. Just off the press.
$12.95

HEAVY DUTY!
Full Wave Bridge
25AMP 50PIV
$1.25

Tantalum Capacitors
1 MFD. .35V. By Kemet. Axial Lead. Best Value! **10/$1.**

New! REAL TIME Computer Clock Chip
N.S. MM5313. Features BOTH 7 segment and BCD outputs. 28 Pin DIP. **$4.95 with Data**

GE 10 AMP Triac
SC146D. House no. To-220 case. Rated 10 amps 400PIV.
75c ea. 3/$2.

LS SERIES TTL

74LS00 — 33c	74LS74 — 49c
74LS02 — 35c	74LS90 — 69c
74LS04 — 35c	74LS138—89c
74LS08 — 35c	74LS154—1.49
74LS10 — 33c	74LS175—1.10
74LS20 — 33c	74LS367—75c
74LS73 — 49c	74LS368—85c

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SEMICONDUCTORS FOR THE EXPERIMENTER

LM373	AM/FM/SSB IF detector (DIP)	$1.95
LM566	Square/triangle oscillator (minidip)	$1.75
LM567	PLL tone decoder (minidip)	$1.85
uA706	DIP audio power amp	$0.75
FET-1	Dual NJFET, VHF/UHF amp, package	3/$1
FET-2	NJFET VHF/UHF amp similar to 2N4416	3/$1
G103	Power transistor (equiv 2N3055)	$0.75

Something Special

RELAY SPECIAL: Beautiful little Electrol reed relays. DPST, N.O., 12V coil; 1" mounting center with 1/10" spaced leads. Now on special at **2/$1.50**

ELECTRIC MOTOR SPECIAL: From time to time we luck out and pick up a True Gizmo. This time, we're offering some of those small DC motors (run on about 1 to 5V DC) you find toys, games, window displays, electric toothbrushes, etc. Now they're on special at **10/$2.95** . . .how can you go wrong?

TRANSISTOR SPECIAL: NPN, house -numbered TO-92 package replaces 2N3904 and similar. Min Beta 250, goes up to 500; reasonable saturation voltage. Priced at **10/$1**.

SOMETHING TO MAKE LIFE EASY: We carry AP test clips for both 14 pin and 16 pin ICs. Gold plated wiping action; sturdy pins for scope probes; also removes ICs from sockets without damage. **Model TC-14 (14 pin): $4.50; Model TC-16 (16 pin): $4.75.** We also carry the A.C.E. **201K breadboarding kit** (with 1,032 solderless plug-in tie point capacity) for only **$24.95**.

TRIMMER CAPACITORS

CV2/8P	2 — 8 pF	5/$2.00
CV2.5/11P	2.5 — 11 pF	5/$2.00
CV3/15P	3 — 15 pF	4/$2.00
CV3.5/14P	3.5 — 14 pF	4/$2.00
CV4/12P	4 — 12 pF	4/$2.00
CV5/25P	5 — 25 pF	4/$2.00
CV5/30P	5 — 30 pF	4/$2.00
CV5.5/18P	5.5 — 18 pF	4/$2.00
CV6/30P	6 — 30 pF	4/$2.00
CV7/25P	7 — 25 pF	4/$2.00
CV8/50P	8 — 50 pF	3/$2.00
CV9/35P	9 — 35 pF	3/$2.00
CV9/45P	9 — 45 pF	3/$2.00
CV15/60P	15 — 60 pF	3/$2.00
CV/ASST.	10 assorted (no choice)	10/$2.00

RF TRANSISTORS

(All specs for the following taken at 25 degrees C at 2 GHz)

#2NRF1 ($4.95) 2 GHz power transistor. Pd max 3.5W, Pout minimum 1.0W, Pin 310 mW, efficiency 30%. Similar to RCA 2N5470.

#2NRF2 ($5.95) 2 GHz power transistor. Pd 8.7W, Pout 2.5W, Pin 300 mW, efficiency 33%. Similar to RCA TA8407.

#2NRF3 ($6.95) 2 GHz power transistor. Pd 21W, Pout 5.5W, Pin 1.25W, efficiency 33%. Similar to RCA 2N6269.

#2NRF4 ($7.95) 2 GHz power transistor. Pd 29W, Pout 7.5W, Pin 1.5W, efficiency 33%. Factory selected prime 2N6269.

YES, WE HAVE COMPONENTS . . .not just some components, either, but a truly wide-range selection. From resistors to sophisticated ICs to experimenter and hobbyist items, before you do any shopping check with us . . . you'll be glad you did.

TERMS: Please allow up to 5% for shipping; excess refunded. Add $1 handling for orders under $10. Cal res add tax. COD OK with street address for UPS. For VISA® /Mastercharge® orders call our order desk (24 hrs) at **(415) 562-0636**. Prices good through cover month of magazine.

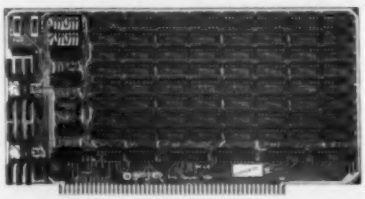
JUST IN TIME — NATIONAL'S 12V CLOCK! $16.50 or 3/$46

The MA1003 clock module is a complete unit . . . just put it in a package and you're on your way. A built-in time base, along with 12V DC operation, make this unit a natural for no-hassle car clock installations. Includes fluorescent readouts (**not** LEDs) for easy visibility under adverse ambient lighting conditions.

SENTRY CRYSTALS . . . these are series mode, fundamental, wire leads, HC18 package. **$4.95** for any of the following: **4 MHz, 5 MHz, 8 MHz, 9MHz, 10MHz, 12 MHz, 15 MHz, 18 MHz, 20 MHz.**

OTHER CRYSTALS: 1.8432 MHz Baud rate generator crystal; HC6 package with wire leads, **$5.95.** 500 KHz, series mode, fundamental, wire leads, HC6/U package, **$4.95.** 1 MHz, series mode, fundamental, wire leads, HC6/U package, **$5.95.** 2 MHz, series mode, fundamental, wire leads, HC6/U package, **$5.90.**

CW AUDIO FILTER: Project #17A. Originally designed as a filter for electronic music applications, our manager Reo Pratt (who is also a ham) reports that his unit gives excellent results as a CW filter with variable range and notch width. Kit form only, **$10.50.**



8K x 8 ECONORAM II™ KIT ($135)

A truly cost-effective package that has drawn raves from both owners and reviewers (see the 1/78 Kilobaud for an example). If you have the space in your motherboard, there's no better way to get 24K of memory than taking advantage of our quantity offer (3 kits for $375). Add $20 to single kit price for assembled/tested.

H8 COMPATIBLE ECONORAM VI™ KIT ($235)

12K x 8 for the H8, with the same features that have made our S-100 boards so popular. Additionally, all sockets and bypass capacitors are already soldered in place so you can get right into the best part of kit building.

TRS-80 16K CONVERSION KIT!
JUST IN — NO TIME TO SET TYPE. CONTAINS 8μPD 416 1x16K DYNAMIC MEMORIES, AND INSTRUCTIONS ON CONVERTING YOUR 4K TRS-80 TO A 16K MACHINE. SAVE $100.
ONLY $190.00 !!

GODBOUT

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614 G4

SOCKET JUMPERS

Mates with two rows of .025" sq. or dia. posts on patterns of .100" centers and shielded receptacles. Probe access holes in back. Choice of 6" or 18" length.

Part No.	No. of Contacts	Length	Price
924003-18R	26	18"	$ 5.38 ea.
924003-06R	26	6"	4.70 ea.
924005-18R	40	18"	8.27 ea.
924005-06R	40	6"	7.33 ea.
924006-18R	50	18"	10.31 ea.
924006-06R	50	6"	9.15 ea.

JUMPER HEADERS

Solder to PC boards for instant plug-in access via socket-connector jumpers. .025" sq. posts. Choice of straight or right angle.

Part No.	No. of Posts	Angle	Price
923863-R	26	straight	$1.26 ea.
923873-R	26	right angle	1.52 ea.
923865-R	40	straight	1.94 ea.
923875-R	40	right angle	2.30 ea.
923866-R	50	straight	2.36 ea.
923876-R	50	right angle	2.82 ea.

DIP JUMPERS

Mates with standard IC sockets
24" length • Fully Assembled & Tested

# CONTS	DESCRIPTION	PART NO.	PRICE
14	sgl. end	924-102-24	$ 1.82
14	dbl. end	924106-24	3.02
16	sgl. end	924112-24	2.13
16	dbl. end	924116-24	3.34
24	sgl. end	924122-24	3.30
24	dbl. end	924126-24	5.20
40	sgl. end	924132-24	5.53

Also Available in 12" and 36" lengths

CRYSTALS

THESE FREQUENCIES ONLY

PART NO.	FREQUENCY	CASE	PRICE
CY1A	1.000MHz	HC33	5.95
CY1.84	1.8432MHz	HC33	5.95
CY2A	2.000MHz	HC33	5.95
CY2.01	2.010MHz	HC33	1.95
CY2.50	2.500MHz	HC33	4.95
CY3.27	3.2768MHz	HC33	4.95
CY3.57	3.579545MHz	HC33	4.95
CY3A	4.000MHz	HC18	4.95
CY4.91	4.916MHz	HC18	4.95
CY7A	5.000MHz	HC18	4.95
CY5.18	5.185MHz	HC18	4.95
CY6.14	6.144MHz	HC18	4.95
CY6.40	6.400MHz	HC18	4.95
CY6.55	6.5536MHz	HC18	4.95
CY12A	10.000MHz	HC18	4.95
CY14A	14.31818MHz	HC18	4.95
CY18A	18.000MHz	HC18	4.95
CY18.43	18.432MHz	HC18	4.95
CY22A	20.000MHz	HC18	4.95
CY30A	32.000MHz	HC18	4.95

TRIMMERS

10MM size trimmers - .394" Dia.

Part No.	1-9	10-24	25-49	100+
TR-11(valve)	.35	.30	.25	.20

Resistance values - 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 1 meg

TRIMPOTS

Single-Turn - 1/2 Watt
Square - Top Adjust - 3/8" Size

Part No.	1-9	10-24	25-49	50-99
63P(value)	.99	.89	.80	.70

Resistance Values - 50, 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1 meg

15-Turn - 3/4 Watt
Rectangular Side Adjust 3/4" x 1/4" Size

Part No.	1-9	10-24	25-49	50-99
43P(value)	1.35	1.25	1.20	1.15

Resistance Values - 50, 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1 meg

1/16 VECTOR BOARD

	0.1" Hole Spacing Part No	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	108P44 062XXXP	4.50	17.00	3.88	3.32
EPOXY	64P44 062WE	4.50	6.50	2.07	1.86
GLASS	64P44 062WE	4.50	8.50	2.56	2.31
	108P44 062WE	4.50	17.00	5.04	4.53
	108P84 062WE	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	108P44 062WEC1	4.50	17.00	6.80	6.12

ELECTRO WRAP

Model P180 includes 2-100' spools #28 AWG wire wrap wire

Supplies insulated wire from spool to wrap-posts without prestripping and precutting using "daisy chain" method.

Model P180 $24.50

REPLACEMENT WRAP BIT for P180 Slit N Wrap
No. P180A $12.95 each

Replacement wire-wrap wire for P180 #28 AWG (pkg. of 3) $2.75 each
W28-2-A green W28-2-B red W28-2-C clear W28-2-D blue

INSTRUMENT/ CLOCK CASE

Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16"

$3.49

MICROPROCESSOR COMPONENTS

P8085	CPU	$29.95	CDP 1802	CPU	$19.95
8080A	CPU	10.95	Z80	CPU	24.95
8212	8-Bit Input/Output	4.95	2650	MPU	26.50
8214	Priority Interrupt Control	7.95	MC6800	MPU	19.95
8216	Bi-Directional Bus Driver	4.95	MC6810API	128 x 8 Static Ram	5.95
8224	Clock Generator/Driver	5.95	MC6820	Periph. Interface Adapter	7.95
8228	System Controller/Bus Driver	5.90	MC6821	Periph. Interface Adapter	11.50
8251	Prog. Comm. Interface	9.95	MC6830L8	1024 x 8 Bit ROM	14.95
8255	Prog. Periph. Interface	10.95	MC6850	Asychronous Comm. Adapter	14.95

RAM'S

1101	256 x 1 Static	$ 1.49	1702A	2048 x 1	$ 5.95
1103	1024 x 1 Dynamic	.99	2102	2048 x 1	14.95
2101	256 x 4 Static	5.95	82S23	32 x 8	5.00
2102	1024 x 1 Static	1.79	82S115	4096 x 1	19.95
2107-B/850	4096 x 1 Dynamic	4.95	82S123	32 x 8	5.00
2111	256 x 4 Static	6.95	74S287	1024 x 1	7.95
2112	256 x 4 Static	5.95	2708	8K	10.95
2114	4K x 1 Static 450ns	8.95	3716 T.I.	16K	29.95
2114L	4K x 1 Static 450ns Low Power	10.95	2716 Intel	16K	59.95
2114-3	4K x 1 Static 300ns	10.95	6301-1	1024 x 1	3.49
2114L-3	4K x 1 Static 300ns Low Power	11.95	6330-1	256 x 1	2.95
7489	16 x 4 Static	1.75	74186	512 x 1	9.95
8101	256 x 4 Static	5.95	74188	256 x 1	3.95
8111	256 x 4 Static	6.95			
8538	16 x 4 Static	3.49	MM5013N	1024 Silvacumulator Dynamic	2.95
21L02	1024 x 1 Static	1.95	MM5016H	500/512 Bit Dynamic	.99
74200	256 x 1 Static	6.95	MM5017N	Dual 506/512 Bit Dynamic	2.95
93421	256 x 1 Static	2.95	2504T	1024 Dynamic	3.95
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MK4116 (UPD416)	16K DYNAMIC 16 PIN	29.95	2522	Dual 132 Bit Static	2.95
TMS4044-45NL	4K STATIC	14.95	2524	512 Dynamic	.99
			2525	1024 Dynamic	2.95

ROM'S

2513(2140)	Character Generator (upper case)	$ 9.95	2527	Dual 256 Bit Static	2.95
2513(3021)	Character Generator (lower case)	9.95	2528	Dual 250 Static	4.00
2516	Character Generator	10.95	2529	Dual 240 Bit Static	4.00
MM5230N	2048 Bit Read Only Memory	1.95	2532	Quad 80 Bit Static	2.95
			2533	1024 Static	2.95

USER MANUALS

1802M	CDP1802 Manual	$ 7.50	3341	Fifo	6.95
Z80M	Z80 Manual	7.50	74LS670	4 X 4 Register	1.95
2650M	2650 Manual	5.00	AY-5-1013	33K BAUD	$ 5.95

UART'S

TELEPHONE

AY-5-9100	$14.95	ICM7205	19.95
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AY-5-9500	4.95	ICM7208	19.95
AY-5-2376	14.95	ICM7209	6.95

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AY-5-9100	$14.95	ICM7205	19.95
AY-5-9280	14.95	ICM7207	7.95
AY-5-9500	4.95	ICM7208	19.95
AY-5-2376	14.95	ICM7209	6.95

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HD0165	7.95	TV GAME CHIP SET	
74C922	9.95	AY-3-8500-1 Chip and 2-910 MHz Crystal	$7.95

NAME READ ONLY

MCM6571	$13.50	1103	2.95
MCM6574	13.50	1702A	4.95
MCM6575	13.50	MCM6810AP	4.95

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1702A	4.95	MC3001P	11.95
MCM6810AP	4.95	MC1408L7	4.95
MC1408L8	5.75	LD110/111	$25.00/set
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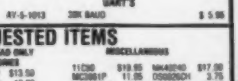
MC1408L8	5.75	93H90	11.95

SPECIAL REQUESTED ITEMS

PARATRONICS
Logic Analyzer Kit
Model 100A
$229.00/kit



- Analyzes any type of digital system
- Checks data rates in excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

(Model 100A Manual - $4.95)

- Some applications are:
  - — Troubleshooting microprocessor hardware, instruction and data flow
  - — Examine contents of ROMS
  - — Tracing operation of control logic
  - — Checking counter and shift register operation
  - — Monitoring I/O sequences
  - — Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for integrated unit).

Model 10 Kit - $229.00
Complete — $9.95
Model 10 Manual — $4.95

B&K PRECISION 3½-Digit Portable DMM

- Overload Protected
- .3" high LED Display
- Battery or AC operation
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- 1mv 10μ, 0.1 ohm resolution
- Overrange reading
- 10 meg input impedance
- DC Accuracy 1% typical

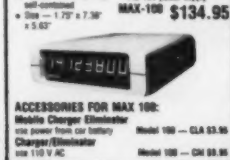
Ranges: DC Voltage: 0-1000V
AC voltage: 0-1000V
Freq. Response: 50-400 hz
DC-AC Current: 0-10mA
Resistance: 0-10 meg ohm
Size: 6.4" x 4.4" x 2"

Accessories:

AC Adapter BC-28	$9.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

Model 2800 $99.95
Comes with test leads, operating manual and spare fuse

CSC 100 MHz 8-Digit Counter



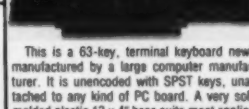
- 20 Hz-100 MHz Range
- .5" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"
- Four power sources, i.e. batteries, 110 or 220V with charger 12V w-th auto lighter adapter and external 7.2-10V power supply

MAX-100 $134.95

ACCESSORIES FOR MAX 100:

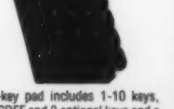
Mobile Charger Eliminator use power from car battery	Model 100 — CLA $3.95
Charger/Eliminator use 110 V AC	Model 100 — CM $9.95

KEYBOARDS
63-Key Unencoded | Hexadecimal Encoder



This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK

$29.95/each



19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key.

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Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark.
Transmit Channel Frequencies	Switch selectable: Low (normal) — 1070 space, 1270 mark; High — 025 space, 2225 mark.
Receive Sensitivity	-46 dbm accoustically coupled.
Transmit Level	-15 dbm nominal. Adjustable from -6 dbm to -20 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	120 VAC, single phase, 10 Watts.
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

The Original the 3rd Hand

$9.95 each

- *Leaves two hands free for working
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- * Position board on angle or flat position for soldering or clipping
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- Bright 6 Digit LED Display
- Times to 59 minutes 59 59 seconds.
- Crystal Controlled Time Base
- Three Stopwatches in One: Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .99" (4¾ switches)
- Uses 3 Penlite Cells

Kit — $39.95
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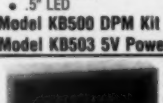
Stop Watch Chip Only (7285) $19.95

iMC 3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit $49.00
Model KB503 5V Power Kit $17.50

JE700 CLOCK



The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout and the MM5314 clock chip.

12 or 24 Hour

115 VAC

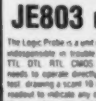
KIT ONLY **$16.95**

JE803 PROBE

The Logic Probe is a unit which is for the most part indispensable in trouble shooting logic families: TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols: (H) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

$9.95 Per Kit
printed circuit board

T²L 5V 1A Supply



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2N5590	10W	175 MHz	MT72	7.80
2N5591	25W	175 MHz	MT72	10.25
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2N6081	15W	175 MHz	MT72	8.45
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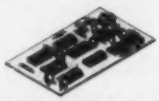

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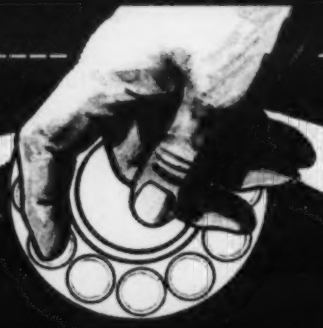

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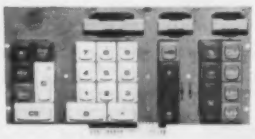

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Social Events

from page 144

Utah) Hamfest will be held on August 4, 5, and 6, 1978, at Macks Inn, Idaho, 25 miles south of West Yellowstone, Montana. Talk-in on 146.34/94 and 3935. Advance registration is $6.00 for adults and $2.00 for children, before July 25th, 1978. Late/regular registration is $7.00 and $2.50. There will be a special prize drawing for preregistration. Please send preregistration to: WIMU Hamfest, 3645 Vaughn Street, Idaho Falls, Idaho 83401; phone (208)-522-9568.

PETOSKEY MI
AUG 5

The 3rd annual Straits Area Radio Club swap and shop will be held on Saturday, August 5, at the Emmet County Fairgrounds, Charlevoix Avenue, Petoskey, Michigan, from 9 am to 3 pm. Talk-in on 146.52. Food services, prizes. Tickets will be $1.50 at the door. Campsites nearby. For information, write to SARC in care of W8IZS, Box 416, Pellston MI 49769.

JACKSONVILLE FL
AUG 5-6

The Jacksonville Hamfest Association is happy to announce the 5th annual Jacksonville hamfest which will be held on August 5 and 6, at the Jacksonville Beach Municipal Auditorium. Activities will include the usual swap tables and exhibitors' displays. Featured programs include a DX presentation by the North Florida DX Assn. on that group's recent DXpedition to Haiti at the invitation of the Haitian government. Shortly after the trip, amateur radio was legalized in Haiti after being outlawed for many years. NFDXA also has two *CQ Magazine* world championships to their credit. A complete seminar on microprocessors will also be featured, along with a "pileup" contest, hidden transmitter hunt, QLF contest, and ARRL meeting. Advanced tickets are now available for $2.50 per person ($3 at the door), with swap tables available for $5 per day. The hamfest site is only one block from the Atlantic Ocean, and those attending can bring their families for a weekend of fun on the beach. Door prizes and hourly drawings will be conducted. All inquiries should be directed to N4UF, Hamfest Chairman, 911 Rio St. Johns Dr., Jacksonville FL 32211. Phone is 744-9501.

SALINE MI
AUG 6

The Arrow Repeater will sponsor its 3rd Annual Swap and Shop on Sunday, August 6, 1978, at the Saline MI fairgrounds. Indoor and outdoor exhibits, refreshments, and prizes will be featured. Doors open at 8:00 am. Check-in on 146.37/97 and 146.52. Admission is $1.50 advance; $2.00 at the door. Display space is $.50/ft. For more info, advance tickets, or table reservations, write Arrow, Box 1572, Ann Arbor MI 48106.

UPPER ST. CLAIR TOWNSHIP PA
AUG 6

The 41st annual hamfest of the South Hills Brass Pounders and Modulators will be held on August 6, 1978, from noon to dusk, at St. Clair Beach on Route 19 south, Upper St. Clair Township. There will be a swap and shop, picnic area, and swimming for the family. Mobile check-in on 29.0 MHz and 146.52 simplex. Information and preregistration for $1.50 ($2.00 at the door) are available from Bruce Banister, 5954 Leprechaun Dr., Bethel Park PA 15102. Vendors must register.

LEVELLAND TX
AUG 6

The 13th annual Northwest Texas Emergency Net Picnic and Swapfest will be held Sunday, August 6, in the city park, Levelland TX. Registration begins at 8 am. Lunch at 12:30 pm. Bring your own picnic basket. Swapping all day with tables provided. This is a family event and is jointly sponsored by the Hockley County Amateur Radio Club and the Northwest Texas Emergency Net. Talk-in on 146.28/88. A $2.00 donation will be appreciated but not required.

DUTZOW MO
AUG 6

The annual Zero-Beaters Amateur Radio Club Hamfest will be held on Sunday, Aug. 6, at the Washington City Park. There is a large area for traders' row; no extra charge to exhibitors for displays. There is a picnic area, refreshments and lunches are available, and there are lots of prizes and activities for the ladies. Ham pilots can fly into our airport. Free transportation will be provided. For more info, write WA0FYA, Dutzow MO 63342.

CHARLOTTE VT
AUG 12-13

The International Field Days and Hamfest sponsored by the Burlington Amateur Radio Club will be held on August 12-13. Door prizes, raffles, contests, bingo for ladies, a two-day flea market, and much more. Chairman Bob W1DQO suggests early reservations for camping sites on site at Old Lantern, Charlotte VT 05445. Early bird registration at $3.00, with gate cost of $3.50. For other info, please write BARC, PO Box 312, Burlington VT 05402.

AMARILLO TX
AUG 11-13

The 1978 edition of the Golden Spread Amateur Radio Convention will be held at the Holiday Inn West Motor Hotel, 601 Amarillo Blvd. West, Amarillo, Texas, on Friday evening, Saturday, and Sunday, August 11, 12, and 13, 1978. It is sponsored by the Panhandle Amateur Radio Club of Amarillo. An area has been set aside for amateurs to display their trading and swapping gear. Two Hospitality Hours are slated: one for early arrivals the evening of Aug. 11 and the second for Saturday evening, Aug. 12. Six technical sessions will be held, featuring the very latest in communications expertise. Special activities for the ladies will be available so that there will be something for everyone. Preregistration will be $4.00 per person; registration at the door will be $6.00.

LEXINGTON KY
AUG 13

The Bluegrass Amateur Radio Club annual hamfest will be held at the National Guard Armory on August 13, starting at 8:00 am. There will be major prizes, forums, refreshments, a paved flea market area, a large indoor exhibit space, and plenty of free parking. Advance tickets are $2.50; $3.00 at the door. Flea market space is $1.00 extra. Talk-in on .16/.76. For more info, contact Paul Heflin WA4PAB, 434 Potomac Dr., Lexington KY 40503, (606)-278-0646.

CEDARTOWN GA
AUG 13

The Cedar Valley Amateur Radio Club of Cedartown, Georgia, will sponsor the Cedar Valley Hamfest, which will be held on August 13, 1978, from 9 am to 4 pm, at the Polk County Fairgrounds located one mile east of Cedartown on US 278. Talk-in frequency will be (WR4AZU) 147.72/.12. Food, drinks and lots of prizes! For more information, please contact Jim T. Schliestett, Pres., W4IMQ, Cedar Valley ARC, PO Box 93, Cedartown GA 30125; telephone: (404)-748-5968.

POMONA CA
AUG 13

The Tri-County Amateur Radio Association will hold its annual hamfest on Sunday, August 13, 1978. Several prizes will be awarded including a Midland 220 MHz transceiver. Drawing tickets are 50¢ each. The winner need not be present. The hamfest/picnic will be at Westmont Park, West 9th Street, ½ mile west of Highway 71. For tickets or info, write to Box 142, Pomona CA 91769.

WILLOW SPRINGS IL
AUG 13

The Hamfesters 44th annual picnic and hamfest will be held on Sunday, August 13, 1978, at Santa Fe Park, 91st and Wolf Road, Willow Springs, Illinois, a southwest suburb of Chicago. There will be exhibits for OMs and XYLs and the famous swappers' row. Tickets at the gate will be $2.00; in advance, $1.50. For hamfest information or advance tickets, send check or money order (SASE appreciated) to Bob Hayes, 18931 Cedar Ave., Country Club Hills, Illinois 60477.

ROCHESTER MN
AUG 18-20

The Central States VHF Society will hold its twelfth annual conference on August 18, 19, and 20, 1978, at the Midway Motor Lodge, Rochester MN. This conference is specifically oriented to operation above 50 MHz. An excellent technical program is planned. A dinner for the conferees and their families, an evening speaker, and prizes are included in the program. For further information, contact the Central States VHF Society, c/o Mr. Mel Larson, 2429 N.W. Viking Court, Rochester MN 55901.

Ham Help

I'm looking for a Heathkit TS-4 TV alignment generator schematic, alignment instructions, voltage chart, and circuit operation description.

Bill Mollenhauer N2FZ
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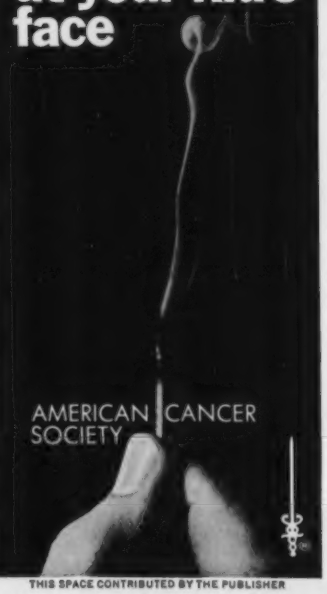

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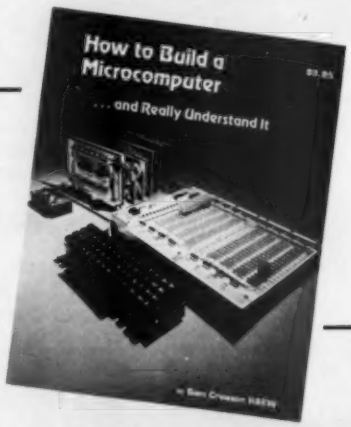

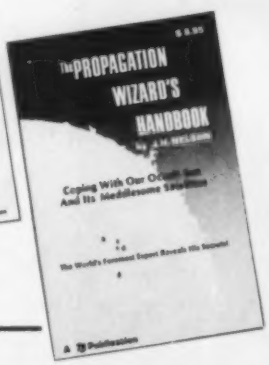

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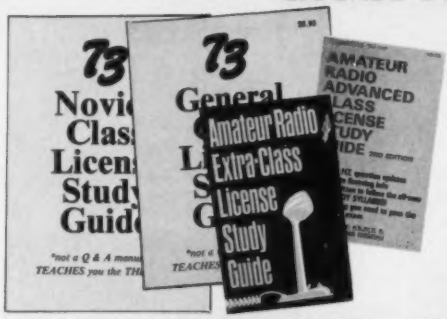

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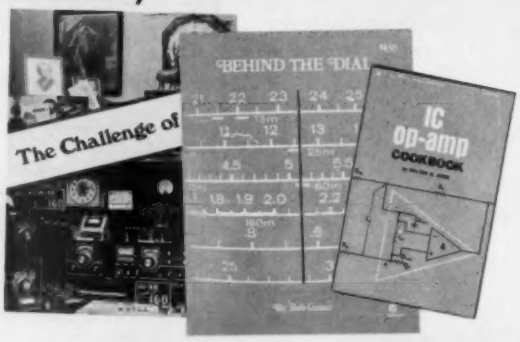

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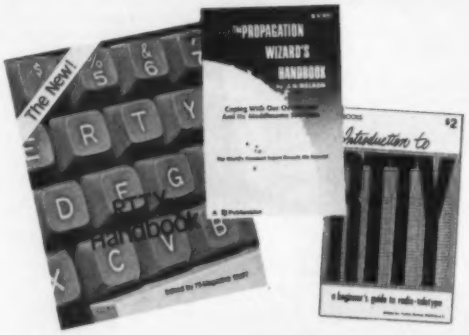

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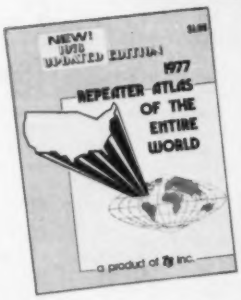

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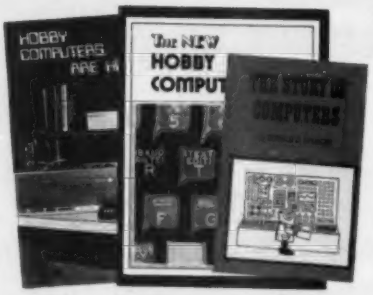

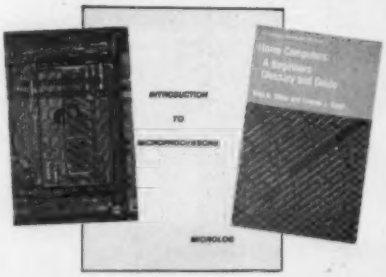

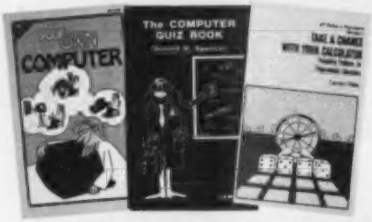

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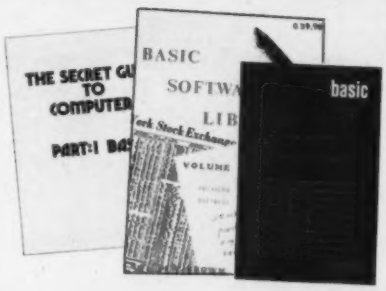

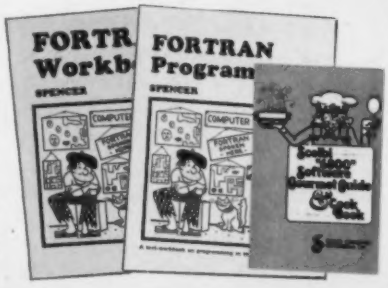

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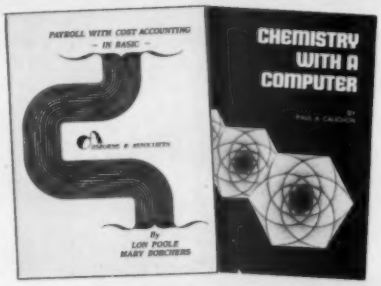

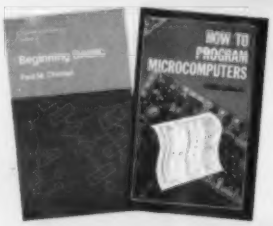

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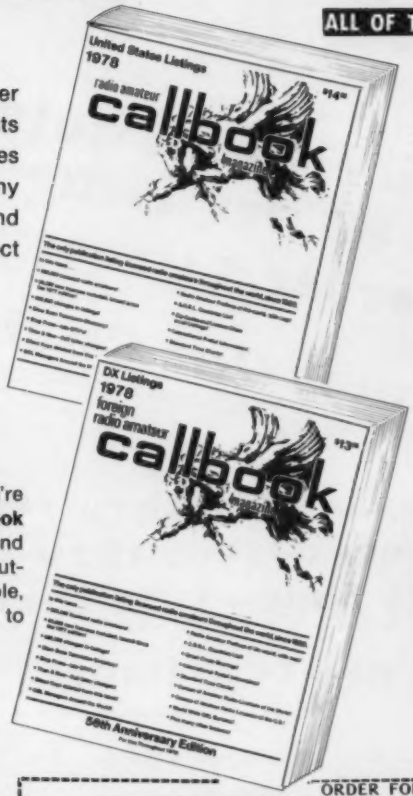

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July

sun	mon	tue	wed	thu	fri	sat
						1 G
2 G	3 G	4 G	5 G	6 F/SF	7 F/SF	8 F/SF
9 P/SF	10 P/SF	11 F	12 G	13 G	14 G	15 G
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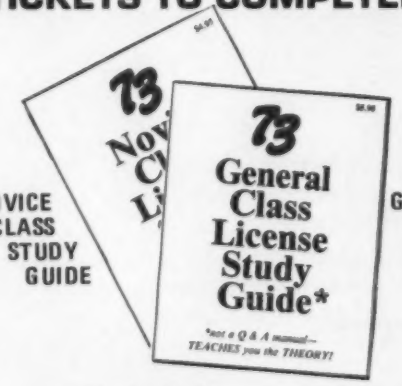

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